# 4

# Environmental Consequences

## 4.1 Introduction

This chapter describes the impacts associated with each of the alternatives that were carried forward for further study (see Section 2.5). A concise summary of this chapter was provided in Section 2.6.

## 4.2 Traffic Impacts

This section describes the future traffic volume condition and summarizes the traffic operating conditions for each of the proposed alternatives. Alternatives include the No Build condition as a base comparison, various highway widening alternatives from the existing two lanes in each direction to either three and/or four lanes in each direction, various interchange configuration options, Transportation System Management (TSM) options to accommodate interim improvements at selected locations, and Transportation Demand Management (TDM) measures.

The criteria used for evaluation are described below.

### 4.2.1 Traffic Criteria

This section describes the procedure used to establish an appropriate design hour volume condition, describes the level of service methodology used for evaluation, and presents the procedure used to determine the basic lane requirements for the highway.

#### 4.2.1.1 Design Hour Volumes

The first step in evaluating the alternatives under a future traffic volume condition is to establish an appropriate traffic volume condition. As described in Section 3.2.2, the $30^{th}$ highest hour volume is used as the appropriate design hour volume for the segments of I-93. The $30^{th}$ highest hour volume is used for design purposes because it is a volume level that is not exceeded very often (only 29 other hours a year), while on the other hand, it is not so high that full use of the facility would only rarely occur.

Based on the data provided at the New Hampshire Department of Transportation (NHDOT) permanent count station located on I-93 in Derry, the 30th highest hour volume is approximately 9.4 percent of the ADT. The Directional Design Hour Volume (DDHV) split shows approximately 60 percent of the total hourly traffic traveling in the peak direction.

The DDHV, which is neither specifically a morning (AM) nor an afternoon/evening (PM) volume, is the design volume in the peak direction that is used to evaluate the segments of I-93 and to determine lane requirements. AM and PM peak hour volumes are used to evaluate interchange and intersection movements. The use of DDHV for mainline analysis and AM and PM peak hour volumes for intersection design is in keeping with national standards.

#### 4.2.1.2 Levels of Service

A level of service analysis, similar to the procedure used to evaluate the existing condition (described in Chapter 3) was conducted for the corridor segments, interchanges, and intersections. Six levels of service are defined ranging in letter designation from LOS A to LOS F, with LOS A representing the best operating condition and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak or design hour traffic flow. LOS D is generally considered acceptable where the cost and impacts of making improvements to provide LOS C are deemed unjustifiable. Level of service E is capacity. The traffic performance measures, and the evaluation criteria used in the operational analyses, are based on the methodology presented in the 2000 Highway Capacity Manual.[34]

In the design of new roadway facilities, the NHDOT has established LOS C as desirable and LOS D as minimally acceptable. However, despite establishing LOS D as the minimally acceptable level of service, the NHDOT has also expressed a general policy of not constructing highways with more than eight basic lanes (four lanes in each direction).[35] Therefore, for the purpose of this evaluation, the objective is to provide at least a LOS D operation in the year 2020 while constructing no more than four basic lanes in each direction.

In addition to the freeway and interchange (merge, diverge and weave) operations, an operational analysis was conducted at signalized intersections located at or near the corridor interchanges for each of the Build Alternatives and for various options. For signalized intersections, level-of-service is based on the delay in seconds experienced by motorists at an intersection. A secondary performance measure, which is not directly related to level-of-service, is the volume-to-capacity (v/c) ratio.

34 2000 Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, D.C.
35 Consideration of more than 8 lanes would only be given if Massachusetts were to propose a widening that involved more than 8 lanes.

The results of the operational analyses at signalized intersections are presented in terms of LOS, delay, and v/c ratio. The relationship between delay and LOS is summarized in this table.

| LOS | Delay (Seconds) |
|---|---|
| A | $\leq$ 10 |
| B | > 10-20 |
| C | > 20-35 |
| D | > 35-55 |
| E | > 55-80 |
| F | > 80 |

### 4.2.1.3 Basic Lane Criteria

The basic lanes of a highway are the travel lanes along a facility that are needed solely to accommodate the movement of through traffic. Basic travel lanes do not include traffic management lanes such as climbing lanes, acceleration/deceleration, collector/distributor, weaving, and merging type lanes, which may be needed in the vicinity of an interchange to accommodate vehicles entering and exiting the highway. These basic lanes serve to provide a consistent number of lanes over a substantial length of highway.

To determine the number of basic lanes that will be needed to accommodate traffic flow along the I-93 study corridor, the level of service criteria was applied to the future year design hour traffic volumes. Each segment of the corridor was evaluated to determine the number of basic lanes that would be needed to provide at least a LOS D operation during the design hour (30th highest volume) in the year 2020.

## 4.2.2 Traffic Model

The purpose of this section is to document the methodology used to develop the traffic volume projections for the study corridor. Specifically, this section describes the development of the I-93 sub-area traffic model that serves as the basis for the traffic volume projections in this report.

In 1994 the NHDOT began an important statewide study to carry the Department's transportation planning into the 21st century. The overall goal of the Statewide Planning Study was to "provide recommendations for developing a coordinated transportation system that would facilitate the movement of persons and goods in a safe, cost-effective, efficient, and environmentally conscious manner." Recommendations from this study were to be directed to all transportation modes in the State of New Hampshire, including highways and public transportation.

The New Hampshire Statewide Travel Demand Model System (NHSTMS) was developed as part of this study. The model helps predict travel behavior (i.e., how people travel by car, bus, etc.) and travel demand (i.e., how many people want to travel on a certain road or by a certain mode). The model is based on statewide data collected on highway, bus, and rail systems, and on land use, and social and economic characteristics. Household travel, roadside motorist, and transit rider surveys were conducted as part of the data collection effort in 1994. The model is intended to identify potential new or improved transportation services and strategies, in an effort to improve overall transportation services, reduce congestion and improve air quality.

The NHSTMS is a tour-based model system consisting of many sub-models, or components. The system is intended to model travel by auto and transit modes for a summer weekday. The base year of the model is 1990 with analysis capabilities for all forecast years ranging from 1997 to 2020, although years beyond 2020 could be analyzed using extrapolation of socio-economic forecasts.

The I-93 sub-area is one of the sub-models or components of the statewide model. The I-93 sub-area model is more detailed, that is, it has smaller, and consequently more, traffic zones and somewhat finer highway networks than the statewide model. The zones and the highway network for the I-93 sub-area model were developed in consultation with the appropriate regional planning commissions, local officials and others. The zones and the network for the I-93 sub-area model are consistent with the statewide overlapping regional models. All links in the statewide transportation network, which are located in the I-93 sub-area, are included in the model.

The trip tables for the I-93 sub-area model were developed from the statewide model. These trip tables were imported into the sub-area model and then traffic assignments were made for the sub-area. The 1997 base year sub-area model was considered to be calibrated when the traffic assignments reasonably reflected the traffic volumes estimates from the NHDOT statewide model on I-93 from the state line to the I-93/I-293 split in Manchester.

Based on the guidelines published in the Federal Highway Administration's Report *Calibration and Adjustment of System Models*[36], the 1997 sub-area model traffic assignments fell within the acceptable range of accuracy for freeways. Similarly, the sub-area model assignments for other major roadways such as NH 28, NH 111, and NH 102 were also compared to actual 1997 data and were determined to be within the acceptable range of accuracy for these types of facilities. Therefore, with the model calibrated, it was determined that the 1997 sub-area model accurately reflects the actual traffic volume conditions within the project area and could be used for planning and forecasting purposes.

36 Calibration and Adjustment of System Models, Federal Highway Administration, December 1990.

Traffic forecasts were made for year 2020 for the I-93 sub-area using the model. The 2020 highway network includes proposed improvements (expected to be completed by 2020) such as the I-293 reconstruction, the Manchester Airport Access Road, the Nashua Circumferential Highway, and the F.E. Everett Turnpike expansion. Traffic forecasts from the I-93 subarea model were compared with traffic forecasts for 2020 from the Southern New Hampshire Planning Commission model, the Manchester Airport Access Model, the Windham-Salem NH 111 model, and the Nashua Regional Planning Commission model, and correlations were found to be acceptable.

## 4.2.3 No-Build Alternative

The No-Build Alternative is essentially the continuation and perpetuation of the existing situation and the shortcomings inherent on the present highway corridor. The No-Build Alternative will serve as a baseline condition for comparison with other alternatives.

The projected 2020 No-Build ADT, DHV and, most importantly for determining the number lanes needed, DDHV for each segment of the corridor are shown in Table 4.2-1. The 2020 future morning and evening peak hour volumes at each of the study corridor interchanges and intersections are shown in **Figures 4.2-1 and 4.2-2**.

As shown in the table, the projected 2020 DDHV ranges from a low of 4,100 vehicles per hour (vph) between Exits 3 and 4 to a high of 7,700 vph south of Exit 1.

**Table 4.2-1**
**2020 Average Weekday and Design Hour Volumes (No Build)**

| Segment | ADT[1] | DHV[2] | DDHV[3] | LOS[4] |
|---|---|---|---|---|
| South of Exit 1 | 137,000 | 12,900 | 7,700 | F |
| Between Exits 1 and 2 | 103,600 | 9,700 | 5,800 | F |
| Between Exits 2 and 3 | 98,000 | 9,200 | 5,500 | F |
| Between Exits 3 and 4 | 73,000 | 6,900 | 4,100 | E |
| Between Exits 4 and 5 | 81,200 | 7,600 | 4,600 | E |
| North of Exit 5 | 84,300 | 7,900 | 4,800 | F |

1 ADT – Average Daily Traffic
2 DHV - Design Hour Volume
3 DDHV - Directional Design Hour Volume
4 LOS – Level-of-Service

The results of the operational analyses indicate that to provide at least a LOS D operation in 2020 would require the following number of basic lanes along the corridor.

➤ 10 lanes (5 lanes in each direction) south of Exit 1,

- 8 lanes (4 lanes in each direction) between Exit 1 and Exit 3, and
- 6 lanes (3 lanes in each direction) between Exit 3 and I-293.

Again, the basic lane requirements are the number of basic lanes, exclusive of traffic management lanes, that are needed to accommodate through traffic along each segment of the I-93 corridor. Note that to provide a LOS D operation along the segment south of Exit 1 would require a five-lane section. This exceeds the NHDOT's general policy of not constructing highways with more than four basic lanes in each direction.

The results of the operational analyses for the 2020 No-Build condition, as summarized in **Figures 4.2-3**, reveal poor operating conditions (LOS E or F) for all segments of the I-93 study corridor from Salem to Manchester. Similarly poor operating conditions would occur at most interchange movements with at least one ramp movement showing a failure condition (LOS F) at every study area interchange. Poor operations, or capacity conditions are projected at each of the signalized intersections at Exit 2, Exit 3, and Exit 5. The signalized intersections at the Exit 4 northbound and southbound ramps show LOS D or better.

In summary, as the volume of traffic continues to increase in the future, under the 2020 No-Build condition, the delays and congestion experienced along the I-93 corridor and at each of the corridor interchanges will not only worsen during the peak hours, but the level of congestion is expected to expand to longer periods of the day and to a greater number of days during the year.

## 4.2.4 Build Alternatives

### 4.2.4.1 Freeway Segment Operations

There are three Build Alternatives that consider the widening (adding lanes) of I-93. The alternatives are:

- Widen I-93 to 4 lanes in each direction for the entire length of the corridor.
- Widen I-93 to 3 lanes in each direction for the entire length of the corridor.
- Widen I-93 to 4 lanes through Exit 3 and to 3 lanes north of Exit 3.

The results of the level of service analyses for the 2020 Build 3-lane and 4-lane alternatives are presented in Table 4.2.2. As shown in the table, the 3-lane cross section would provide at least LOS D (the established minimally acceptable condition) for each of the segments north of Exit 3, however the segments south of Exit 3 would operate at LOS E (capacity) or LOS F (failure condition).

Under the 4-lane alternative, the segments north of Exit 2 would operate at LOS C (the established desirable condition) or better with the segment between Exit 1 and

Exit 2 operating at LOS D. Note that the segment between the state line and Exit 1 would operate at LOS E under the 4-lane alternative. A 5-lane (each direction) cross section would be needed along the segment south of Exit 1 to provide a LOS D operation. However, a 5-lane section would exceed the NHDOT's recommendation of not constructing highways with more than 4 basic lanes in each direction.

**Table 4.2-2**
**Freeway Segment Analysis Summary**
**2020 No-Build and 2020 Build – Three-Lane and Four-Lane Alternatives**

| | No-Build | | Three-Lanes | | Four-Lanes | |
|---|---|---|---|---|---|---|
| Segment | DDHV[1] | LOS[2] | DDHV | LOS | DDHV | LOS |
| MA State Line to Exit 1 | 7,700 | F | 8,000 | F | 8,100 | E |
| Exit 1 to Exit 2 | 5,800 | F | 6,400 | E | 6,600 | D |
| Exit 2 to Exit 3 | 5,500 | F | 6,100 | E | 6,100 | C |
| Exit 3 to Exit 4 | 4,100 | E | 4,300 | C | 4,300 | B |
| Exit 4 to Exit 5 | 4,600 | E | 4,700 | C | 4,800 | C |
| North of Exit 5 | 4,800 | F | 5,000 | D | 5,000 | C |

1 DDHV – Directional Design Hour Volume
2 LOS – Level-of-Service

It is important to recognize that the future design hour volumes represent the volume of traffic during a one-hour period. However, because the peak commuter period currently extends beyond a single hour, the design hour is expected to experience an inflow of volume from the hour before and hour after the design hour as the capacity of the highway is increased with the widening. The principal benefit of the additional capacity will be the shrinking of the nearly 3-hour congestion period that is experienced today by motorists. Also note that as additional lanes are provided on I-93, there is expected to be a modest increase in the DDHV. This increase in volume reflects the expected diversion of traffic from nearby roadways as capacity is added to I-93.

### 4.2.4.2 Interchange Operations

In addition to the freeway segment evaluation, level of service analyses were conducted for the ramp and intersection movements at each of the corridor interchanges for a series of different interchange configurations. The ramp and intersection analyses for the various interchange configurations are summarized in Tables 4.2-3 and 4.2-4.

As shown in the tables, all of the ramp movements for the various interchange configurations would operate at an acceptable LOS D or better under the I-93 Four-Lane Alternative. Under the Three-Lane Alternative, the ramp movements at Exits 4 and 5 would continue to show acceptable operation, however ramp movements at Exits 1, 2 and 3 would experience some LOS F levels.

**Table 4.2-3**
**Interchange (Ramp Junction) Analysis Summary - 2020 Build**

| | Level of Service | | | |
|---|---|---|---|---|
| | 4-Lane | | 3-Lane | |
| **Interchange** | **AM** | **PM** | **AM** | **PM** |
| ***Exit 1*** | | | | |
| NB off to CD Rd. (with 2 lane off ramp) | A | B | NA | NA |
| NB on from CD Rd. to I-93 | A | C | NA | NA |
| NB on ramp | B | C | NA | NA |
| SB off ramp | C | B | NA | NA |
| ***Exit 2*** Option: Diamond & Loop | | | | |
| NB off ramp | B | D | C | F |
| NB on ramp | A | C | B | F |
| SB off ramp | D | B | F | C |
| SB on ramp | B | B | D | C |
| ***Exit 3*** Options: 1-9 | | | | |
| NB off ramp (with 2 lane off-ramp) | A | C | A | F |
| NB on ramp | A | C | A | B |
| SB off ramp | C | B | D | B |
| SB on ramp (with 2 lane on-ramp) | B | A | F | B |
| ***Exit 4*** Options: East & West | | | | |
| NB off ramp (with 2 lane off-ramp) | A | A | A | B |
| NB on ramp | B | B | B | C |
| SB off ramp | B | B | C | C |
| SB on ramp (from E) | B | A | C | B |
| SB on ramp (from W) | B | B | C | B |
| ***Exit 5*** Options: Diamond & NB Relocate | | | | |
| NB off ramp | B | B | B | C |
| NB on ramp | B | B | B | C |
| SB off ramp | B | C | C | C |
| SB on ramp | B | B | C | C |

NA = Not applicable. Build Alternatives at Exit 1 only considered with I-93 4-lane cross-section.

**Table 4.2-4**
**Signalized Intersection Analysis Summary – 2020 Build Alternative**

| | | Only Option | | | | | |
|---|---|---|---|---|---|---|---|
| **Exit 1** | **Period** | **v/c**[1] | **Delay**[2] | **LOS**[3] | | | |
| Rockingham Park Boulevard at Mall Entrance | AM Peak | 0.54 | 10.5 | B | | | |
| | PM Peak | 0.63 | 12.6 | B | | | |
| | | **Diamond Alternative** | | | **Loop Ramp Option** | | |
| **Exit 2** | **Period** | **v/c** | **Delay** | **LOS** | **v/c** | **Delay** | **LOS** |
| Pelham Rd (NH 97) at SB Ramps/Keewaydin Dr. | AM Peak | NA | NA | NA | 0.77 | 29.4 | C |
| | PM Peak | NA | NA | NA | 0.85 | 35.9 | D |
| Pelham Rd (NH 97) at SB Ramps | AM Peak | 0.54 | 14.6 | B | NA | NA | NA |
| | PM Peak | 0.74 | 20.9 | C | NA | NA | NA |
| Pelham Rd (NH 97) at NB Ramp | AM Peak | 0.57 | 19.9 | B | 0.57 | 19.9 | B |
| | PM Peak | 0.62 | 19.6 | B | 0.62 | 19.6 | B |
| Pelham Rd (NH 97) at Policy St | AM Peak | 0.91 | 26.9 | C | 0.91 | 26.9 | C |
| | PM Peak | 0.86 | 29.3 | C | 0.86 | 29.3 | C |
| Pelham Rd (NH 97) at Keewaydin Dr. | AM Peak | 0.55 | 6.8 | A | NA | NA | NA |
| | PM Peak | 0.89 | 27.5 | C | NA | NA | NA |
| Pelham Rd (NH 97) at Stiles Rd & Manor Pkwy. | AM Peak | 0.75 | 24.5 | C | 0.75 | 24.5 | C |
| | PM Peak | 0.93 | 50.6 | D | 0.93 | 50.6 | D |
| | | **Options 1-9** | | | | | |
| **Exit 3** | **Period** | **v/c** | **Delay** | **LOS** | | | |
| NH 111 at NH 111A | AM Peak | 0.69 | 28.4 | C | | | |
| | PM Peak | 0.82 | 23.4 | C | | | |
| | | **Options 1,3, 5** | | | **Options 2, 4, 6-9** | | |
| | | **v/c** | **Delay** | **LOS** | **v/c** | **Delay** | **LOS** |
| NH 111 at NB Ramps | AM Peak | 0.65 | 13.7 | B | 0.71 | 17.6 | B |
| | PM Peak | 0.96 | 31.5 | C | 0.95 | 36.0 | D |
| | | **Options 1-4, 7,8** | | | **Options 5, 6, 9** | | |
| | | **v/c** | **Delay** | **LOS** | **v/c** | **Delay** | **LOS** |
| NH 111 at SB Ramps | AM Peak | 0.71 | 19.7 | B | 0.43 | 10.7 | B |
| | PM Peak | 0.87 | 13.0 | B | 0.87 | 9.0 | A |
| | | **Options 3-6, 8,9**[4] | | | | | |
| | | **v/c** | **Delay** | **LOS** | | | |
| NH 111 at Wall St | AM Peak | 0.75 | 11.5 | B | | | |
| | PM Peak | 0.97 | 29.9 | C | | | |

N/A= Not Applicable.
1 Volume to capacity ratio.
2 Average delay per vehicle in seconds.
3 Intersection level of service.
4 Option 1, 2 and 7 do not include a traffic signal at NH 111/Wall Street intersection.

### Table 4.2-4 (continued)

| | | Only Option | | |
|---|---|---|---|---|
| Exit 4 | Period | v/c[1] | Delay[2] | LOS[3] |
| NH 102 at SB Ramp | AM Peak | 0.55 | 11.7 | B |
| | PM Peak | 0.72 | 17.6 | B |
| NH 102 at SB Ramp (with single SB right) | AM Peak | 0.71 | 15.5 | B |
| | PM Peak | 0.93 | 29.3 | C |
| NH 102 at NB Ramps | AM Peak | 0.71 | 19.4 | B |
| | PM Peak | 0.89 | 34.0 | C |
| NH 102 at Gilcreast Rd | AM Peak | 0.86 | 29.0 | C |
| | PM Peak | 0.99 | 54.6 | D |
| NH 102 at Hampton Dr | AM Peak | 0.71 | 13.0 | B |
| | PM Peak | 0.91 | 26.8 | C |
| NH 102 Fordway Extension | AM Peak | 0.76 | 22.5 | C |
| | PM Peak | 1.17 | 92.8 | F |

| | | Reconstruct/Relocate NH 28 Option | | | Relocate NB Ramps w/Liberty Dr. Option | | |
|---|---|---|---|---|---|---|---|
| Exit 5 | Period | v/c | Delay | LOS | v/c | Delay | LOS |
| NH 28 at SB Ramps | AM Peak | 0.53 | 22.8 | C | 0.53 | 22.8 | C |
| | PM Peak | 0.58 | 23.3 | C | 0.58 | 23.3 | C |
| NH 28 at NB Ramps | AM Peak | 0.48 | 17.5 | B | 0.85 | 44.4 | D |
| | PM Peak | 0.65 | 18.0 | B | 0.83 | 44.3 | D |

N/A= Not Applicable.
1 Volume to capacity ratio.
2 Average delay per vehicle in seconds.
3 Intersection level of service.
4 Option 1, 2 and 7 do not include a traffic signal at NH 111/Wall Street intersection.

At Exit 1, each of the ramp movements would operate at LOS C or better (under the 4-lane option) while the nearby signalized Rockingham Park Boulevard/Mall Entrance intersection would operate at LOS B. At Exit 2, both the Diamond and the Loop Ramp options eliminate the existing difficult weave area between the southbound on and off-ramps with all ramp movements under either option operating at LOS D or better. Each of the signalized intersections on Pelham Road would operate at LOS D or better. Note that under the Loop option, the need for a traffic signal at the southbound on-ramp is eliminated.

At Exit 3, each of the ramp movements would operate at LOS D or better (under the 4-lane alternative), while the signalized intersections near the interchange would operate at LOS C or better for all of the nine interchange configuration options. Under the NH 111 on-line option, which would consist of a 3-lane section extending from the interchange westward to the signalized intersection at the Village Green Plaza, vehicle queues would be expected to back up from the Village Green intersection to the interchange. Left turn movements from the side streets along the 3-lane section would be difficult. In contrast, the NH 111 relocation option, which would provide a 5-lane cross section on a new alignment to the north of existing NH 111 would provide added capacity to accommodate vehicle queuing. The existing section of NH 111 would be converted to a frontage road. The frontage road would connect to NH 111 opposite Wall Street, west of Exit 3, at a new signalized intersection, which would provide safer and more efficient access to NH 111 from the side streets and driveways accessing NH 111 in its current location.

At Exit 4, each of ramp movements would operate at LOS B or better under the 4-lane alternative and LOS C or better under the 3-lane alternative. The nearby signalized intersections would all operate at LOS D or better with the exception of the NH 102/Fordway intersection that would operate at LOS F as it does today and would under the No-Build condition.

At Exit 5, each of the ramp movements would operate at LOS C or better. The signalized NH 28/Southbound Ramp intersection would operate at LOS C, while the NH 28 Northbound Ramp intersection would operate at LOS B. The northbound ramp intersection, under the option to relocate it opposite Liberty Drive, would operate at LOS D.

### 4.2.4.3 Park and Ride Facilities

Interchange operations for the 2020 Build Alternative at I-93 Exits 2, 3, and 5 were also evaluated assuming the construction of new park and ride facilities. Operational analyses were performed for each interchange assuming full utilization of a 500-space park and ride facility supported by bus service. Section 2.3.5.4 provides a description of each park and ride lot alternative evaluated and summarizes additional improvements that would be made to the existing roadways to accommodate access to the facilities.

The analysis results indicate that the Exit 2 and Exit 3 interchanges and adjacent signalized intersections would operate at the same level of service with and without a new park and ride facility. All intersections would continue to operate at LOS D or better through 2020. No additional improvements would be needed at the interchanges to support the park and ride facilities.

Five park and ride lot alternatives were evaluated for the Exit 5 interchange. Similar to Exits 2 and 3, the analysis results revealed no substantial change in traffic operations associated with the park and ride facility. The intersection of NH 28 and the I-93 southbound ramps would continue to operate at LOS C or better through 2020. The intersection of NH 28 and the northbound ramps would continue to operate at LOS B with the NH 28 on-line option and LOS D with the relocation of the northbound ramps with Liberty Drive. No additional improvements would be needed at the interchange to support the park and ride facility.

Operational analyses were also performed at the driveways to each of the park and ride facilities for the 2020 Build Alternative at I-93 Exits 2, 3 and 5. The results are summarized in Table 4.2-5. As shown in the table the Exit 2 Park and Ride lot driveway at the intersection of South Policy Street and Raymond Avenue would operate at a good level of service (LOS B or better).

Two options were evaluated at Exit 3. Under the Northbound Shift option (Option 1) the park and ride driveway, which intersects NH 111 at a signalized T-type intersection, would operate at LOS A. Under the Northbound/Southbound Tight Shift option (Option 2) the park and ride facility would have two access points: a right-in/right-out driveway onto NH 111 and a full access driveway onto NH 111A. NH 111 right-in/right-out driveway would operate at LOS C or better. All movements at the NH 111A driveway would operate good levels of service (LOS B or better) with the exception of the shared left/through movement exiting the park and ride facility, which would operate at LOS C in the AM and LOS E in the PM.

Five park and ride lot alternatives were evaluated at Exit 5. The signalized intersection of Symmes Drive and NH 28 would operate at a good level of service (LOS B) under Options 1 and 2, and would operate at LOS C or better under Option 3. The signalized intersection of NH 28 and Liberty Drive would operate at LOS C under Option 4 and LOS D under Option 5. The right-turn exiting movement from Auburn Road onto NH 28 would operate at LOS B under Option 4 and LOS C or better under Option 5.

## Table 4.2-5
## Park and Ride Intersection Analysis Summary – 2020 Build Alternatives

| Exit 2 Location | Period | v/c[1] | Delay[2] | LOS[3] | | | |
|---|---|---|---|---|---|---|---|
| South Policy Street / | AM Peak | 0.51 | 8.2 | A | | | |
| Raymond Ave (s) | PM Peak | 0.73 | 18.8 | B | | | |
| **Exit 3** | | **NB Shift - Option 1** | | | **NB / SB Tight Shift - Option 2** | | |
| **Location** | **Period** | **v/c[1]** | **Delay[2]** | **LOS[3]** | **Demand[4]** | **Delay** | **LOS** |
| NH Route 111 / | AM Peak | 0.56 | 6.2 | A | - | - | - |
| Park & Ride Driveway (s) | PM Peak | 0.65 | 6.3 | A | - | - | - |
| NH 111 / Park &Ride Drive (u) | | | | | | | |
| -Right turn out | AM Peak | - | - | - | 5 | 12.0 | B |
| -Right turn out | PM Peak | - | - | - | 65 | 17.0 | C |
| NH 111A / Park & Ride Drive (u) | | | | | | | |
| -LT from NH 111A NB | AM Peak | - | - | - | 5 | 8.3 | A |
| -LT from NH 111A SB | | - | - | - | 10 | 8.6 | A |
| -All from Edgewood | | - | - | - | 45 | 13.4 | B |
| -LT/TH from Park & Ride | | - | - | - | 70 | 19.4 | C |
| -RT from Park & Ride | | - | - | - | 0 | 10.3 | B |
| NH 111A / Park & Ride Drive (u) | | | | | | | |
| -LT from NH 111A NB | PM Peak | - | - | - | 0 | 8.8 | A |
| -LT from NH 111A SB | | - | - | - | 40 | 8.2 | A |
| -All from Edgewood | | - | - | - | 30 | 12.1 | B |
| -LT/TH from Park & Ride | | - | - | - | 165 | 36.9 | E |
| -RT from Park & Ride | | - | - | - | 15 | 13.0 | B |
| **Exit 5** | | **Options 1-2** | | | **Option 3** | | |
| **Location** | **Period** | **v/c[1]** | **Delay[2]** | **LOS[3]** | **v/c[1]** | **Delay** | **LOS** |
| NH 28 / | AM Peak | 0.48 | 19.0 | B | 0.46 | 18.1 | B |
| Symmes Drive (s) | PM Peak | 0.55 | 19.9 | B | 0.68 | 25.7 | C |
| **Exit 5** | | **Option 4** | | | **Option 5** | | |
| **Location** | **Period** | **v/c[1]** | **Delay[2]** | **LOS[3]** | **v/c[1]** | **Delay** | **LOS** |
| NH 28 / | AM Peak | 0.65 | 28.1 | C | 0.88 | 41.8 | D |
| Liberty Drive (s) | PM Peak | 0.83 | 34.0 | C | 0.92 | 41.2 | D |
| | | **Demand** | **Delay** | **LOS** | **Demand** | **Delay** | **LOS** |
| NH 28 / Auburn Road (u) | | | | | | | |
| -RT from Auburn Road | AM Peak | 475 | 13.8 | B | 550 | 17.9 | C |
| -RT from Auburn Road | PM Peak | 280 | 11.5 | B | 380 | 12.1 | B |

1 Volume to capacity ratio.
2 Average delay per vehicle expressed in seconds.
3 Intersection level of service (approach level of service for unsignalized locations).
4 Volume expressed in vehicles per hour.
(s) Signalized intersection.
(u) Unsignalized intersection.

■

### 4.2.5 Transportation Systems Management

Transportation Systems Management (TSM) refers to short range, moderately priced measures aimed at reducing congestion and enhancing safety on the existing transportation system or roadway network. As described in Section 2.3.2, a series of geometric upgrades at the interchanges located at Exits 2 through Exit 5 were evaluated. The possible actions include:

- **Exit 2** – Extend the northbound on-ramp to provide greater distance for vehicles to enter the highway and for trucks to get up to speed. Upgrade Pelham Road to provide a four-lane cross section in the vicinity of the interchange.
- **Exit 3** – Widen the northbound off-ramp to provide double left-turn lanes onto NH 111 westbound. Better delineate and channelize the right-turn movement onto the southbound on-ramp.
- **Exit 4** – Extend the left-turn storage lane for the NH 102 eastbound left-turn movement onto the I-93 northbound on-ramp.
- **Exit 5** – Lengthen the southbound off-ramp and widen the shoulder area on I-93 approaching the ramp in response to long queue that currently backs onto I-93. Modify the signal timing at the southbound ramp to increase "green time" for the southbound off-ramp approach.

These TSM actions can provide some short-term relief, but would not address the long-term safety and capacity needs of the highway.

■

### 4.2.6 Transportation Demand Management

Transportation Demand Management (TDM) encompasses a variety of strategies that are designed to change personal travel behavior to reduce the demand for automobile use and the need for highway capacity expansion. TDM measures typically provide means by which commuter (and travelers) can reach destinations utilizing alternatives to the single occupancy of motor vehicles. TDM measures include consideration of infrastructure investments to provide and expand alternative modes of transportation such as HOV lanes, park and ride facilities, bicycle facilities, bus services, and rail service.

Section 2.3.4, Transportation Demand Management, and Section 2.3.5, Mode Alternatives, describe various strategies considered. TDM measures that encourage the use of bus transit, employer shuttles, ride matching are currently being employed within the corridor and enhancement of these strategies would to some extent reduce the number of single occupancy vehicles. As described in Section 3.2.8.4, recently the State of NH in a cooperative effort with the State of Massachusetts implemented express bus service for New Hampshire employees working at a bio-pharmaceutical company in Andover, Massachusetts.

Additional cooperative efforts will be evaluated and considered within the corridor to provide similar commuter service between NH park and ride facilities and employment centers in Massachusetts. Among the centers to be considered are:

- The River Road TMA in Andover
- The Junction TMO (Transportation Management Organization) serving the Ballardvale Street and Lowell Junction area in Andover and Wilmington
- The Artery Business Committee TMA in Boston
- Commuter Works/MASCO in Boston (Longwood Medical and Academic Area)
- The Interinstitutional TMA in Boston (Boston Medical Center)
- The Logan TMA at Logan Airport
- The Seaport TMA in South Boston
- The Charles River TMA in Cambridge
- The 128 Business Council TMA

From the experience and "lessons learned" involving the recently implemented service to Wyeth Bio-Pharma, additional enhanced bus service will be initiated.

New park and ride facilities to provide the necessary support for transit services and ultimately help support TDM measures are proposed along I-93 at Exits 2, 3, and 5. The proposed facility at Exit 3 would replace the existing facility west of Exit 3. The existing park and ride facility at Exit 4 would continue to provide bus service. Expanded bus service (that is, bus service to Boston from the new park and ride facilities) is proposed. Legislation to provide for the purchase of buses has been initiated. By providing such capital investments, it is expected that bus providers will be able to implement the proposed expanded service. The new park and ride lots will also facilitate enhanced bus service to major employers along I-93 in northern Massachusetts.

## 4.3 Air Quality Impacts

The air quality analysis presents the results of the regional and local air quality evaluation of the I-93 Transportation Corridor Project. The regional evaluation discusses the proposed project's compliance with Transportation Conformity and the local evaluation presents a microscale analysis that evaluates the carbon monoxide (CO) hotspot impacts. Background information on current conditions and attainment status is contained in Section 3.3.

■

### 4.3.1 Transportation Conformity

The U.S. Department of Transportation (USDOT) and the U.S. Environmental Protection Agency (USEPA) have established conformity procedures to ensure that transportation projects are in compliance with State Implementation Plans (SIPs). Conformity requires that the proposed transportation projects be part of an MPO adopted Transportation Improvement Program (TIP) for urbanized areas and the total emissions of all projects should meet the air quality budgets established in the SIPs. The I-93 Salem to Manchester project was included in the NHDOT's Statewide Transportation Improvement Program (STIP) for Fiscal Years 2001-2003, and was also included in the "Fiscal Year 2001 Conformity Determination." The STIP, which includes this project, was approved by the USDOT as satisfying the transportation conformity requirements. Since the regional air quality impacts of the I-93 Salem to Manchester Transportation Corridor Project were addressed in the transportation conformity analysis, no additional analysis of regional emissions is required, and none have been included in this air quality study.

NHDOT evaluated the air quality impacts of widening I-93 from Salem to Manchester to 3 lanes in each direction and with 4 lanes in each direction for the Ozone analysis years of 2012 and 2022. This analysis was based on the regional transportation model runs by the Southern New Hampshire Planning Commission and the Rockingham Planning Commission.

It is anticipated that the total air quality emissions (VOC and NOx in kgs/day) for the I-93 Salem to Manchester widening project under either of the scenarios (3 lanes in each direction or 4 lanes in each direction), along with the air quality emissions from other transportation projects in the region will be within the air quality emission budgets for the analysis years of 2012 and 2022, and would meet the Conformity requirements for the Southern NH Serious non attainment area.

The air quality study includes a microscale modeling analysis that predicts CO levels at critical receptor locations along the project corridor. The microscale analysis was conducted according to USEPA guidelines. The results of the air quality analysis demonstrate that the proposed project will not interfere with the attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for CO. These results are consistent with the study area's designation as attainment for CO.

■

### 4.3.2 Alternatives

Chapter 2 presents a discussion of the evaluation of alternatives that were considered and presents the alternatives that were recommended for further evaluation. The air quality study (see Section 3.3) ranked all of the intersections from the alternatives that were selected for further evaluation based upon total traffic volumes and levels of service. The three intersections with the highest traffic volumes and the three intersections with the worst levels of service, regardless of which alternative they came from, were selected for evaluation. In addition, the air quality study evaluated the right-of-way area (i.e., "open space") along the segment of I-93 with the highest traffic volumes. These intersections are listed in Section 3.3.2.2. Microscale Analysis. The air quality study assumes that if these intersections meet the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

The air quality analysis represents a worst-case condition because it used the traffic data from the 4-lane alternative. The CO results would be lower if the traffic data from the 3-lane alternative was used. The air quality analysis demonstrates that both the 4-lane and 3-lane alternatives would meet the NAAQS.

■

### 4.3.3 Project Impacts

The microscale analysis was conducted to determine whether the proposed project complies with the Clean Air Act Amendments (CAAA) and SIP criteria. Tables 4.3-1 and 4.3-2 present the maximum predicted 1-hour and 8-hour CO concentrations, respectively, for the 1997 Existing, 2010 No-Build, 2010 Build, 2020 No-Build, and 2020 Build conditions. The tables include those receptor locations that exhibited the highest CO concentrations for each quadrant of each intersection.

The results of the microscale analysis show that, under all future conditions (2010 and 2020 No-Build and Build), predicted CO concentrations at all receptor locations are below predicted concentrations for 1997 Existing Conditions. These reductions in CO concentrations can be attributed to more efficient vehicles with enhanced emissions control technologies as mandated by the Federal Motor Vehicle Exhaust Emissions Control Program for new vehicles entering the fleet. The results of the microscale analysis also demonstrate that the proposed project satisfies the SIP criteria for CO because all the 1997, 2010, and 2020 No-Build and Build CO concentrations (both 1 hour and 8 hour values) are below the NAAQS of 35 and 9 ppm, respectively. The results for each intersection and the I-93 right-of-way analyzed are discussed below.

## Table 4.3-1
## Predicted Maximum 1 Hour CO Concentrations (Parts Per Million)[1]

| Receptor No. and Location[2] | 1997 Existing | 2010 No-Build | 2010 4-Lane[3] Build | 2020 No-Build | 2020 4-Lane[3] Build |
|---|---|---|---|---|---|
| **Fordway Extension and NH 102** | | | | | |
| 1. 80 West Broadway | 4.8 | 3.7 | 3.7 | 3.9 | 3.9 |
| 2. 55 West Broadway | 8.3 | 4.9 | 4.8 | 4.8 | 4.7 |
| 3. 49 West Broadway | 6.8 | 4.3 | 4.2 | 4.2 | 4.2 |
| 4. 78 West Broadway | 4.8 | 3.7 | 3.7 | 3.8 | 3.9 |
| **I-93 Exit 3 Northbound Ramp and NH 111** | | | | | |
| 5. Open Space Southwest Quadrant | 9.4 | 7.0 | 7.1 | 8.0 | 8.1 |
| 6. 123/125 Indian Rock Road | 10.1 | 7.4 | 7.8 | 8.0 | 8.3 |
| 7. Open Space/Country Corner Store | 10.2 | 7.5 | 7.7 | 8.0 | 8.4 |
| **I-93 Exit 2 Southbound Ramp, Pelham Road, and Keewaydin Drive** | | | | | |
| 8. 25 Pelham Road | 10.5 | 7.8 | 6.6 | 8.0 | 7.3 |
| 9. Open Space Northwest Quadrant | 9.0 | 6.9 | 6.6 | 7.5 | 7.2 |
| 10. Open Space Southeast Quadrant | 10.1 | 7.3 | 9.3 | 9.1 | 9.7 |
| 11. Open Space Northeast Quadrant | 8.3 | 6.3 | 6.1 | 7.2 | 6.7 |
| **I-93 Exit 2 Northbound Ramp and Pelham Road** | | | | | |
| 12. Open Space Northwest Quadrant | 10.3 | 7.6 | 6.7 | 8.1 | 7.3 |
| 13. Open Space Southwest Quadrant | 10.6 | 8.4 | 6.9 | 8.9 | 7.6 |
| 14. Open Space Southeast Quadrant | 10.0 | 7.5 | 6.6 | 8.2 | 7.1 |
| 15. Open Space Northeast Quadrant | 10.7 | 8.0 | 6.9 | 8.9 | 8.0 |
| **I-93 Right-of-Way** | | | | | |
| 16. Open Space | 4.2 | 3.7 | 3.7 | 3.9 | 3.7 |

Source: Vanasse Hangen Brustlin, Inc.

1 The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 2.0 ppm. The 1-hour NAAQS for CO is 35 ppm.

2 The air quality study assumes that if these intersections meet the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.

3 The air quality analysis was based upon traffic data from the 4-Lane Alternative. The CO results would be lower for the 3-Lane Alternative.

**Table 4.3-2**
**Predicted Maximum 8 Hour CO Concentrations (Parts Per Million)[1]**

| Receptor No. and Location[2] | 1997 Existing | 2010 No-Build | 2010 4 Lane[3] Build | 2020 No-Build | 2020 4 Lane[3] Build |
|---|---|---|---|---|---|
| **Fordway Extension and NH Route 102** | | | | | |
| 1. 80 West Broadway | 4.0 | 3.2 | 3.2 | 3.3 | 3.3 |
| 2. 55 West Broadway | 6.4 | 4.0 | 4.0 | 4.0 | 3.9 |
| 3. 49 West Broadway | 5.4 | 3.6 | 3.5 | 3.5 | 3.5 |
| 4. 78 West Broadway | 4.0 | 3.2 | 3.2 | 3.3 | 3.3 |
| **I-93 Exit 3 Northbound Ramp and NH Route 111** | | | | | |
| 5. Open Space Southwest Quadrant | 7.2 | 5.5 | 5.6 | 6.2 | 6.3 |
| 6. 123/125 Indian Rock Road | 7.7 | 5.8 | 6.1 | 6.2 | 6.4 |
| 7. Open Space/Country Corner Store | 7.7 | 5.9 | 6.0 | 6.2 | 6.5 |
| **I-93 Exit 2 Southbound Ramp, Pelham Road, and Keewaydin Drive** | | | | | |
| 8. 25 Pelham Road | 8.0 | 6.1 | 5.2 | 6.2 | 5.7 |
| 9. Open Space Northwest Quadrant | 6.9 | 5.4 | 5.2 | 5.9 | 5.6 |
| 10. Open Space Southeast Quadrant | 7.7 | 5.7 | 7.1 | 7.0 | 7.4 |
| 11. Open Space Northeast Quadrant | 6.4 | 5.0 | 4.9 | 5.6 | 5.3 |
| **I-93 Exit 2 Northbound Ramp and Pelham Road** | | | | | |
| 12. Open Space Northwest Quadrant | 7.8 | 5.9 | 5.3 | 6.3 | 5.7 |
| 13. Open Space Southwest Quadrant | 8.0 | 6.5 | 5.4 | 6.8 | 5.9 |
| 14. Open Space Southeast Quadrant | 7.6 | 5.9 | 5.2 | 6.3 | 5.6 |
| 15. Open Space Northeast Quadrant | 8.1 | 6.2 | 5.4 | 6.8 | 6.2 |
| **I-93 Right-of-Way** | | | | | |
| 16. Open Space | 3.5 | 3.2 | 3.2 | 3.3 | 3.2 |

Source: Vanasse Hangen Brustlin, Inc.
1 The concentrations are expressed in parts per million (ppm) and include a 8-hour background concentration of 2.0 ppm. The 8-hour NAAQS for CO is 9 ppm.
2 The air quality study assumes that if these intersections meet the NAAQS, then all other intersections, regardless of alternative, which will have lower volumes and better levels of service, can be assumed to also meet the NAAQS.
3 The air quality analysis was based upon traffic data from the 4-Lane Alternative. The CO results would be lower for the 3-Lane Alternative.

## Fordway Extension and NH 102

The maximum 1-hour CO concentrations predicted for the existing (1997) condition range from 4.8 to 8.3 ppm. Under the No-Build Alternative, the maximum predicted 1-hour CO concentrations in 2010 range from 3.7 to 4.9 ppm, and in 2020, from 3.8 to 4.8 ppm.

The maximum 2010 1-hour Build Alternative concentrations are predicted to range from 3.7 to 4.8 ppm and from 3.9 to 4.7 ppm in the 2020 Build Alternative. A comparison with the No-Build Alternative indicates that construction of the I-93 project will result in very little change in predicted concentrations for this intersection area.

### I-93 Exit 3 Northbound Ramp at NH 111

The maximum 1-hour CO concentrations predicted for the existing (1997) condition range from 9.4 to 10.2 ppm. Under the No-Build Alternative, the maximum predicted 1-hour CO concentrations in 2010 range from 7.0 to 7.5 ppm, and in 2020, were 8.0 ppm.

The maximum 2010 1-hour Build Alternative concentrations are predicted to range from 7.1 to 7.8 ppm and from 8.1 to 8.4 ppm in the 2020 Build Alternative. A comparison with the No-Build Alternative indicates that construction of the I-93 project will result in slightly higher predicted concentrations for this intersection.

### I-93 Exit 2 Southbound Ramp, Pelham Road and Keewaydin Drive

The maximum 1-hour CO concentrations predicted for the existing (1997) condition range from 8.3 to 10.5 ppm. Under the No-Build Alternative, the maximum predicted 1-hour CO concentrations in 2010 range from 6.3 to 7.8 ppm, and in 2020, from 7.2 to 9.1 ppm.

The maximum 2010 1-hour Build Alternative concentrations are predicted to range from 6.1 to 9.3 ppm and from 6.7 to 9.7 ppm in 2020 Build Alternative. Construction of the I-93 project would result in slightly higher predicted concentrations at one of the receptor locations. The remaining receptor locations at this intersection will experience small reductions.

### I-93 Exit 2 Northbound Ramp and Pelham Road

The maximum 1-hour CO concentrations predicted for the existing (1997) condition range from 10.0 to 10.7 ppm. Under the No-Build Alternative, the maximum predicted 1-hour CO concentrations in 2010 range from 7.5 to 8.4 ppm, and in 2020, 8.1 to 8.9 ppm.

The maximum 1-hour CO 2010 Build Alternative concentrations are predicted to range from 6.6 to 6.9 ppm in 2010 and from 7.1 to 8.0 ppm in 2020 Build Alternative. Construction of the I-93 project would result in similar or slightly lower predicted concentrations for this intersection.

### I-93 Right-of-Way

A single receptor location representing the highway right-of-way south of Exit 1 was evaluated to represent the worst case CO concentrations along I-93, as the highest traffic exists and are projected to occur at this location. The receptor was located

70 feet (21 meters) from the nearest travel lane. The maximum 1-hour CO concentration predicted for the existing (1997) condition was 4.2 ppm. Under the No-Build Alternative, the maximum predicted 1-hour CO concentration in 2010 was 3.7 ppm, and in 2020, 3.9 ppm.

The maximum 1-hour CO 2010 Build Alternative concentration is 3.7 ppm for both 2010 and 2020. Construction of the I-93 project would result in similar CO concentrations along the I-93 right-of-way.

The results of the air quality study demonstrated the maximum 1-hour concentrations for each intersection were below the NAAQS of 35 ppm for all conditions analyzed. The maximum predicted 8-hour CO concentrations for each intersection are presented in Table 4.3-2. All of the maximum 8-hour CO concentrations are also well below the 8-hour NAAQS of 9 ppm.

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## 4.3.4 Construction Impacts

Air quality in the study area would not be substantially affected by project construction because of the temporary nature of highway construction and the confined right-of-way. Emissions from the operation of construction machinery (nitrogen oxides, sulfur oxides, carbon monoxide, and particulate matter) are short-term and not generally considered substantial.

Mitigating fugitive dust emissions involves minimizing or eliminating its generation. Mitigation measures that will be used for construction include wetting and stabilization to suppress dust generation, cleaning paved roadways, and scheduling construction to minimize the amount and duration of exposed earth.

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## 4.3.5 Park and Ride Facilities

This project includes the establishment or maintenance of park and ride facilities to support carpool and transit services. Currently, there are two existing park and ride facilities, one west of Exit 3, and one at Exit 4. New facilities are proposed at Exits 2 and 5, along with relocation of the Exit 3 facility closer to the interchange. While the air quality analysis did not quantify the emission reductions from the use of the new and expanded park and ride facilities, their implementation will result in some additional improvements to air quality in the study area by promoting alternative forms of transportation that will reduce the number of single occupant vehicles using I-93.

### 4.3.6 Conclusion

The air quality analysis demonstrates that this project is in compliance with the 1990 Clean Air Act Amendments and the New Hampshire State Implementation Plan. The results of the microscale analysis demonstrate that the proposed project will not create CO violations in locations, where violations do not currently exist. In fact, the results demonstrate that no CO violations currently exist in the air quality study area. The microscale analysis also demonstrates that CO concentrations for the No-Build and Build Alternatives are all predicted to be below the NAAQS standards for CO.

This project also satisfies the transportation conformity requirements because it was evaluated as an improvement in the NHDOT's State Transportation Improvement Program (STIP) for Fiscal Years 2001-2003, which was reviewed by USEPA and found to conform by the U.S. Department of Transportation.

In summary, the results of the air quality analysis demonstrate that the proposed project is in conformance with the SIP because:

- No new violation of the NAAQS will be created,
- No increase in the frequency or severity of any existing violations will occur, and
- No delay in attainment of any NAAQS standards will result.

## 4.4 Water Resources Impacts

### 4.4.1 Surface Water

#### 4.4.1.1 Introduction

This section presents an analysis of potential impacts to the surface water resources within the study area associated with the proposed project alternatives. The principal project alternatives include the No-Build Alternative which serves as a baseline condition for comparison with other alternatives that include three mainline Build Alternatives. The three Build Alternatives propose adding lanes to I-93, and include two alternatives, which widen I-93 to either three or four lanes in each direction for the entire length of the corridor (i.e., Three-Lane and Four-Lane Alternatives), or a third Combination Alternative that widens I-93 to four lanes through the Exit 3- Interchange area and three lanes north of Exit 3. The impact analyses focused primarily on the Four-Lane Alternative as it represents the worst-case scenario. In addition to widening I-93, each of the five interchanges in the project area will be reconstructed to improve traffic flow and address safety concerns. Each interchange generally has various design alternatives that typically involve only minor differences in ramp alignments and local roadway configurations. The Exit 3 Interchange in Windham, however, has nine (9) different design options including a partial relocation of NH 111 and the possible shifting of the I-93 northbound and southbound lanes to narrow the existing median area through the interchange area. A bike path and new park and ride facilities at Exits 2,3 and 5 are also included in the proposed project.

The analysis of potential surface water impacts has three separate components. One component focuses on highway runoff and involves estimating the net change in the theoretical pollutant load for each stream under the No-Build and Build Alternatives by evaluating the potential increase in roadway area and the expected treatment effects of the various water quality treatment measures being proposed under the Build Alternatives. The theoretical pollutant load is based on the expected increase in roadway area in each watershed. The potential treatment effects are based on typical removal efficiencies, where runoff from both the existing and new roadway area would be treated. A relative comparison of the amount of I-93 pavement area within each of the watersheds of the streams and rivers under the No-Build and proposed Build Alternatives is also provided. The comparison is used to identify the resources that may be most susceptible to water quality impacts, due to the anticipated increases in pavement area, and related highway runoff as measured by the percentage of I-93 roadway area within the watershed area.

The second component of the impact analysis includes an evaluation of the potential changes in phosphorus loading to the principal lakes in the study area, as a result of the increased roadway area and related runoff discharges. Phosphorus has been found to be contained in highway runoff and can be a principal concern for downstream lakes. Phosphorus is generally the limiting nutrient for plant and algae growth in New Hampshire waters. Increased inputs of phosphorus to lakes can stimulate and promote algal growth, which can lead to nuisance conditions that can interfere with the recreational use of the lake as well as a decline in water quality conditions. As algal growth increases, water clarity decreases, which reduces the sunlight penetration to the bottom layers and affects the aquatic life communities and certain beneficial plant species. Each year as algal cells die off, the organic matter sinks to the bottom and consumes oxygen as part of the decomposition process. As this cycle progresses, lakes continue to have increasing algal growth and tend to have little to no oxygen in the bottom layers for extended periods of the year. Highly productive lakes, with an abundance of aquatic weed and algal growth are generally referred to as being “eutrophic”, while lakes having minimal algal productivity and excellent water clarity are classified to be “oligotrophic”. Lakes between the two extremes are classified as being “mesotrophic”.

The third component of the impact analysis involves estimating the potential changes in the long-term sodium and chloride concentrations in each of the streams and rivers as a result of the increased deicing applications needed to maintain the added travel lanes. Both the USEPA and NHDES have established a secondary drinking water standard of 250 mg/l for both sodium and chloride (ENV-WS 319.01: State Water Quality Standards) to avoid aesthetic problems associated with taste. NHDES has also established aquatic life criteria for chloride in fresh water resources to protect aquatic life from the possible adverse effects related to osmotic pressure imbalances (i.e., disruption of molecular exchanges through cell membranes) in high saline waters (Env-Ws 1700). The chronic and acute criteria for chloride have been set at 230 and 860 mg/l, respectively, to protect aquatic life. A mass balance analysis was conducted to estimate the average annual in-stream chloride concentrations based on the proposed number of travel lanes in each watershed, an average annual application rate for road salt and an estimated average stream flow rate during the winter months.

The following sections describe in greater detail the methods, assumptions and the results of each the separate components of the impact analysis.

### 4.4.1.2 Impact Analysis Methodology

#### Highway Runoff

As presented in Section 3.4, there are twenty-one (21) different streams and rivers that are located within or immediately adjacent to the study area that extends over roughly 20.0 miles from Massachusetts to the City of Manchester. These streams range in size from very small tributaries that have watershed areas of less than 150 acres with flow paths of less than a 0.5 mile and are likely to only support seasonal intermittent flow to several larger streams with watershed areas of more than 5,000 acres that flow for many miles and have substantial year-round flow. The larger streams include the Spickett River, the Cohas Brook and Beaver Brook. There are also five lakes or ponds that are located within or downstream of the I-93 roadway corridor and receive flow from one of the tributary streams. The most important lakes include Canobie Lake and Cobbetts Pond, which are discussed further below. The other three ponds are quite small and are less than 10 acres in size and are not on the list of public water bodies maintained by the New Hampshire Department of Environmental Services (NHDES). All of these water resources are currently affected to some degree by the existing I-93 roadway, since they receive varying amounts of highway runoff during storm events. The proposed project is not expected to affect any new or additional water bodies that are not currently affected.

Previous research sponsored by the Federal Highway Administration (FHWA) has shown that highway runoff can contain various contaminants and if available in excessive amounts and left untreated, these contaminants can cause deleterious effects on aquatic life in receiving waters (Dupuis et al, 1985). The primary sources of these contaminants include both atmospheric deposition and those derived from vehicular traffic associated with vehicle exhaust and the wear and tear of moving parts such as tires and brake linings. Another potential source relates to the components of deicing materials, mostly sodium and chloride, which are applied during the winter months to maintain safe travel conditions.

Certain trace metals such as copper and zinc are common components of highway runoff and are linked to the wear and tear of brake linings and the tire rubber, respectively (Dupuis et al., 1985). Studies have found that the accumulation of copper and zinc on pavement tends to increase with increasing traffic volumes. Some of the older FHWA studies have also indicated that lead was once prevalent in highway runoff due to the lead content in leaded gasoline. However, since the introduction of unleaded gasoline more than 25 years ago, lead is no longer a major concern as it relates to highway runoff. Other runoff constituents**,** such as phosphorus and nitrogen, are primarily derived from atmospheric deposition on the pavement. An increase in pavement area will generally result in an increase in pollutant load primarily because of the increase in runoff volume but also due to the increased impervious area allows for more pollutants to accumulate and be washed be washed off later in the next storm event.

Several predictive models have been developed over the years to try predict the amount of highway-related pollutants that may be generated from a given roadway area based on several related factors such as traffic levels, pavement area, estimated streamflow and surrounding land use conditions (Driscoll et al. 1990). However, these models have had limited success in accurately predicting the potential pollutant load and the resulting in-stream concentration for various streams (Coleman et. al., 2001). One principal problem is that the model user, with little to no site-specific data, must somewhat arbitrarily select or determine an appropriate initial pollutant concentration that best represents both existing and future pollutant levels in highway runoff as well as background levels contributed from other sources in the watershed. This determination is extremely difficult to do with any reasonable accuracy, particularly with respect to assessing the difference between existing and future highway runoff conditions, given the numerous interacting variables that affect pollutant concentrations in runoff. Typically, the results produced by these types of predictive procedures are associated with a large margin of error.

The following analysis involves a different approach. Rather than rely on the predictive models, the analysis focuses on estimating the potential net change in the theoretical pollutant load to each stream based on the amount of increased roadway area and the level of water quality treatment (i.e., extended-detention basins and grassed swales) that has already been included into the preliminary design plans of the proposed Build Alternatives. Thus, given the anticipated amount of increased roadway area, the amount of roadway area that will be directed to a treatment device and the anticipated treatment efficiency of the selected device, the net change in pollutant load can be determined.

As a worst-case analysis, it seems reasonable to assume that the potential pollutant load to the area streams would increase in proportion to the amount of new roadway area created within each watershed under the proposed project alternatives.

Essentially, if the amount of roadway area is expected to increase by 100 percent in each of the watersheds, then the future pollutant contributions would increase by 100 percent. In other words, if the existing pollutant contribution to the area streams is represented by X, than the future contribution would then be 2(X) or twice the existing load. However, if under the proposed Build Alternatives, runoff from the entire roadway, including the existing and the newly created portions, is directed to properly designed extended-detention basins, and, assuming an average removal efficiency of 60 percent, then the resulting pollutant load would be (2X)(1-0.6) or (2X - 1.2X) or 0.8X, or 20 percent less than the anticipated pollutant contributions under the No-Build Alternative.

The key aspect of this approach relies on providing adequate water quality treatment along the entire project corridor, using the best available technology to treat and enhance runoff quality. This is considered to be a better approach than trying to predict in-stream pollutant concentrations using the predictive models and then trying to determine where impacts may or may not occur, and where specific runoff treatment measures may be necessary. If extended-detention basins and grassed swales can be provided in enough locations to treat runoff from nearly the entire roadway, including both existing and new roadway area, then the proposed project results in a net benefit to the area water resources. Assuming an overall removal efficiency of 60 percent runoff from nearly 80 percent of the total roadway area in each watershed would have to be directed toward extended detention basins to achieve a no net increase in pollutant contributions in comparison to the No-Build Alternative.

It is worth noting, that this is considered to be a highly conservative analysis since studies have shown that the pollutant load or the availability of most pollutants in highway runoff is not solely dependent on the amount of pavement area, but other factors such as vehicular traffic levels, highway drainage features, precipitation patterns, and local land use conditions. Thus, the future pollutant load under the proposed Build Alternatives, without accounting for any treatment, are not likely to be twice the amount expected under the No-Build Alternative or based solely on the added pavement, as assumed above.

To estimate the amount of new right-of-way area that would be required for each extended-detention basin, it was assumed that each basin would need sufficient storage to detain and prolong the release of the “first-flush” volume (i.e., ½ inch of runoff over all impervious area) for approximately 30 hours and have a minimum length to width ratio of 4 to 1. This design criteria exceeds the NHDES design guidance, which recommends a minimum detention time of 24 hours for the design storm event and a minimum length to width ratio of 3 to 1 (NHDES 1992). Previous studies have found that detaining stormwater for 24 hours or more can remove as much as 90 percent of the total suspended solids (TSS) and 60 percent of the available nutrients and trace metals contained in runoff (NHDES 1996). Where appropriate, a shallow marsh or permanent pool will be included to enhance removal efficiencies and minimize potential re-suspension of accumulated sediments. The shallow marsh or wet-storage volume will be provided by setting the first-flush outlet at least 12 inches above basin floor. The basin will have multiple outlets at varying elevations to detain the smaller runoff events and provide peak flow control for the 2-year and 10-year storm events. An emergency spillway will be provided to pass the estimated peak flow rate produced from 50-year storm event.

The preliminary design assumptions for the proposed grassed swales include a minimum length of 100 feet, a minimum flow depth and flow velocity for a two (2) year storm event of 6 inches and 1.0 feet per second, respectively. The minimum swale slope will be 0.5 percent and total height of the swale will accommodate the estimated flow volume from 10 year storm event. Research has shown that grassed swales designed in accordance with the above criteria can provide removal efficiencies as high as 80 percent for TSS and 60 percent for other pollutants such as lead. NHDES suggests a more probable range of 20 to 40 percent for TSS and nutrient removal and 10 to 20 percent removal for trace metals. This does not include the additional removal/filtration that may occur in the typical roadside swales located along the roadway that will be used to convey runoff to these stormwater Best Management Practices (BMPs).

Another step in the analysis involved a comparison of the percentage of existing and proposed I-93 roadway area within each of the stream watersheds to identify the surface water resources that may be more prone to water quality impacts. The watershed boundaries and the estimated sizes were determined based on the topographic data presented on the relevant US Geological Survey topographic mapping. The estimated size of the drainage area generally refers to the area that is upgradient of the highway corridor. The amount of existing roadway was based on a total pavement width of 76 feet, which includes two 12-foot travel lanes and an inside and outside shoulder width of 4 and 10 feet, respectively, for both the northbound and southbound travel lanes. The amount of roadway area associated with the existing on and off ramps at each of the interchanges was also included. The estimated proposed roadway area was based on the preliminary design plans for the Four-Lane Alternative. The Four-Lane Alternative would add an additional 68 feet of pavement width or nearly double the existing pavement width of 76 feet (38 feet in each direction). The anticipated new ramp area was also included based on the preferred interchange design options. The Three-Lane Alternative would result in a total of an additional 44 feet of pavement width along the mainline or roughly 35 percent less than the total pavement width under the Four-Lane Alternative.

### Phosphorus Impact Methodology

Phosphorus in highway runoff primarily originates from atmospheric deposition on the pavement. Atmospheric deposition can occur as components of precipitation (rain, sleet or snow) or as dry deposition from fine particulates or dust in the air. Phosphorus in runoff can also be attached to fine sand particles that may be present from previous winter sanding or deicing operations as well as that from sediment that may have eroded along steep embankments. During storm events, the accumulated sediment and attached phosphorus is then washed away and conveyed by highway runoff. Again, it is conservatively assumed that the amount of phosphorus contributed to the area resources will increase proportionally with increased pavement. Thus, if the existing pavement area associated with the roadway is widened by one or two lanes in either direction resulting in an increase pavement area of 50 to 100 percent, respectively, then the associated phosphorus contributions would also increase by a similar amount, without accounting for any water quality treatment that would be included the drainage system. For most lakes, especially those that have a fair amount of residential, commercial and/or agricultural land use or activity within their watersheds, highway runoff is generally a smaller component of the total phosphorus load to the lake. There are many other sources of phosphorus including malfunctioning septic systems, lawn and agriculture fertilizers, animal wastes including that from pets, birds and waterfowl, eroded sediments and runoff from parking lots and other impervious surfaces. Even the direct atmospheric contributions to the lake can account for up to 20 percent of the total phosphorus inputs to the lake (USEPA 1986). This analysis focuses on highway runoff from I-93 and does not factor in the contributions from other sources.

Previous sampling efforts conducted by volunteer lake monitoring groups provide existing data on in-lake phosphorus concentrations and other limnological conditions (see Section 3.4.1.2). Using this existing data, the potential changes in the in-lake phosphorus concentrations attributable to I-93 runoff were estimated under the No-Build and Build Alternatives using the modified Vollenweider model, as presented by FHWA (Driscoll 1990). The model calculates an average annual in-lake phosphorus concentration based on the input parameters of lake surface area, lake volume, the average annual inflow volume and the annual phosphorus load from the highway. The estimated phosphorus load from the highway is based on the roadway area, percent imperviousness in the right-of-way area, the average annual precipitation amount and an assumed phosphorus concentration based on previous sampling data from similar highway conditions.

For each of the project alternatives, a total phosphorus concentration of 0.4 mg/l was used, which represents the runoff concentration observed on 50 percent of the urban highways that had average daily traffic levels above 30,000 vpd (Driscoll 1990). The accuracy of the initial phosphorus concentration in highway runoff is not as important in this analysis, since the concentration is expected to be the same under both the No-Build and the Build Alternatives with the primary source of phosphorus being atmospheric deposition. The 0.4 mg/l concentration is considered to be a reasonably high estimate for this region. The total phosphorus load is expected to increase under the Build Alternatives simply because of the increased pavement area and associated runoff volumes. The potential treatment effects provided by the proposed extended-detention basins and grassed swales under the proposed Build Alternatives are then factored into the analysis. Based on NHDES guidance, it is assumed that the extended-detention basins and the proposed grass swales will reduce the total phosphorus load by 60 and 40 percent, respectively (NHDES 1996).

### Sodium and Chloride Impact Methodology

In addition to the highway runoff constituents discussed above, additional sodium and chloride will be released to area waters due to the increased deicing applications required to maintain the added travel lanes with the proposed Build Alternatives. The added sodium and chloride conveyed by surface runoff can be a threat to both drinking water quality and aquatic life. The NH Department of Environmental Services has established a secondary drinking water standard of 250 mg/l for chloride (WS-319.01) to avoid problems associated with taste. Similarly, both acute and chronic aquatic life criteria have also established for chloride associated with sodium at 230 and 860 mg/l, respectively. Excessive levels of sodium chloride can have detrimental effects on freshwater organisms by disrupting their osmotic balance.

A mass balance analysis was conducted to estimate the long-term average annual concentrations of chloride and sodium in the receiving streams attributable to the I-93 roadway under the No-Build and the proposed Build Alternatives. The analysis is based on the following assumptions:

- All of the applied road salt reaches the receiving waters with the year of application.
- None of the sodium and chloride is attenuated within the road side soils or proposed treatment measures.
- On average, road salt is applied at annual rate of 21 tons per lane-mile on major highways (NHDOT, 2002).
- The average annual recharge to the area streams is equivalent to half of the average annual precipitation or roughly 21 inches, which is equivalent to 1.7 cfs per square mile of drainage area.

## 4.4.1.3 Surface Water Impact Analysis Results

### Highway Runoff

Table 4.4-1 presents a comparison of the estimated watershed area, the amount of I-93 roadway area and the percentage of I-93 roadway area in each watershed under the No-Build and proposed Four-Lane Alternative for the twenty-one (21) different streams and rivers that were identified within the project area.

Under the No-Build Alternative, the results indicate that for all but two streams in the project area, the amount of I-93 roadway area comprises less than 5.0 percent of the overall watershed area. The two streams where more than 5.0 percent of the drainage area was comprised of I-93 roadway area include the south tributary to

Canobie Lake and the northeast tributary to Cobbetts Pond. The south tributary to Canobie Lake has a relatively small watershed with more than a 1.0 mile of I-93 roadway in its watershed. The tributary to Cobbetts Pond, or Dinsmore Brook, also has a relatively small watershed area and contains most of the roadway area associated with the Exit 3 Interchange.

Under the proposed Four-Lane Alternative, eleven of the streams are estimated to have less than 5 percent of their watershed area comprised of I-93 and associated interchange roadway area. Fifteen streams would have less than 6 percent of their watershed areas comprised the same roadway area. Five streams are estimated to have 6 to 8 percent of their watersheds comprised of I-93 and associated interchange roadway area. The highest percentage consists of 26.0 percent and this pertains to the northeast tributary to Cobbetts Pond, which contains nearly all of the roadway area associated with Exit 3 and nearly a mile of both the I-93 northbound and southbound lanes and NH 111. In the Canobie Lake watershed, approximately 5.4 acres of roadway area that currently drains to the lake will be diverted into the Porcupine Brook watershed. This change as well as the proposed relocation of the northbound on and off-ramps, under the "Tight Shift" Alternative will result in a small net increase in the amount of I-93 roadway (i.e., approximately 1.5 acres) in the Canobie Lake watershed. The proposed park and ride facility could add another 4 to 6 acres of paved areas.

Table 4.4-1 also shows the proposed roadway station locations for extended-detention basins and/or grass treatment swales and the estimated amount of new and reconstructed roadway that could be treated through the use of these measures within each watershed. Project-wide, as many as fifty (50) different extended-detention basins and twenty four (24) grassed swales were roughly sized and located based on a preliminary drainage analysis. The results of the preliminary drainage analysis indicates that with the Four-Lane Alternative, runoff from nearly all the new and reconstructed roadway could be treated by either proposed extended-detention basins or grassed swales. There are a few short sections of roadway where detention basins or grass swales are not planned including a 500- to 800-foot section of roadway at the southerly end of the project area where the new roadway transitions back into the existing roadway at the state border. This is primarily due to topographic constraints. This section of roadway drains to the Spickett River.

In at least thirteen (13) watersheds, extended detention basins are being proposed to treat runoff from more than 95 percent of the new and reconstructed roadway area. In four (4) other watersheds, extended-detention basins are being proposed to treat more than 80 percent of the new and reconstructed roadway area. Grass swales would be used to treat the other remaining portions of the roadway area. As discussed in Section 4.4.1.2, if nearly 100 percent of the new and reconstructed roadway area under the Four-Lane Alternative can be treated by extended-detention basins (i.e., 60 percent removal efficiency), this could potentially result in a 20 percent reduction in pollutant contributions to each of the surface water resources associated with I-93 runoff relative the No-Build Alternative. As mentioned earlier, if 80 percent of the roadway area is treated by extended-detention basins, then a no net increase in pollutant load would be expected. This is based on a conservative assumption that the potential load could increase in proportion to the amount of new roadway area.

In addition, it appears that adequate water quality treatment can be provided in the high value watersheds and particularly, in the streams that drain to the area lakes. In many key watersheds, such as in the northeast tributary to Cobbetts Pond, as many as six (6) extended-detention basins and one (1) grass swale are being proposed in order to treat runoff from nearly 100 percent of the roadway area. This would result in a substantial benefit to Cobbetts Pond relative to the No-Build Alternative.

In three (3) watersheds, 65 to 73 percent of the total roadway area is currently being proposed for treatment by extended–detention basins and the rest of the roadway area by grassed swales. These streams include the tributary to Porcupine Brook at Exit 1, the north tributary to Flatrock Brook and the south tributary to Beaver Brook. In these streams, there is the potential for a slight increase in pollutant contributions from highway runoff based on the conservative assumptions used in this analysis. The level of increase is expected to be minimal and not result in any measurable impacts to water quality or their designated uses.

As mentioned earlier, additional treatment measures are not being proposed for the initial 500-800 feet of roadway draining to the main stem of the Spickett River. The Spickett River will however benefit from the extensive treatment proposed for its tributaries including the tributary to Harris Brook, Policy Brook, Porcupine Brook, and the tributary to Porcupine Brook, which, on average, are expected to have more than 85 percent of the roadway area treated by extended-detention basins and grass swales. The Spickett River is located at the southern end of the project area and is not actually crossed by the I-93 roadway.

A more detailed drainage analysis will need to be conducted as part of the final design process to verify actual detention basin locations and whether there are any right-of-way acquisition or drainage constraints that might affect the ability to collect runoff along the entire length of roadway or convey runoff to a proposed detention basin location. Additional stormwater treatment measures will be included as part of the final design process to treat runoff from the proposed park and ride facilities. In general, these facilities are not located directly adjacent to any of the major surface water resources with the exception of the proposed facilities at Exits 3 and 5 which are located within the watersheds of Canobie Lake and Little Cohas Brook, respectively. The pavement area associated with these park and ride facilities are estimated to range roughly between 4.0 to 6.0 acres depending on which design alternative is selected. There appears to be adequate space available to construct extended-detention basins near these facilities.

## Table 4.4.1
## Comparison of Drainage Area, I-93 Roadway Area and Percentage of I-93 Roadway Area Associated Within Each of the Watersheds of the Streams and Rivers in the Study Area Under the No-Action and Build Alternatives

| | Roadway Area | | | | | | Proposed Treatment | | Percent Treatment[3] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Resource | Est. Drainage Area (ac) | No-Build (acres) | Percent[1] (RA/DA) | Build (4 Lane) (acres) | Percent[1] (RA/DA) | Roadway Stations | Detention Basins | Grassed Swales | Detention Basins | Grassed Swales |
| Spickett River[2] | >40,000 | 48.2 | 0.1 | 107.5 | 0.3 | NA | NA | NA | | |
| Tributary to Harris Brook | 330 | 13.9 | 4.2 | 26.5 | 8.0 | 1006-1061 SB<br>1006-1061 NB | 1025 SB[3]<br>1043 SB | NA | >95 %[4] | NA |
| Policy Brook | 3,500 | 12.4 | 0.3 | 32.7 | 0.5 | 1061-1078 SB<br>1184-1200 SB<br>1061-1181 NB<br>1184-1202 NB<br>Exit 1&2 NB on/off-ramps | 1156 NB<br>1060 NB<br>1182 NB | 1160 NB<br>1160 SB | 92 % | 8 % |
| Tributary to Porcupine Brook (Exit 1) | 350 | 8.7 | 2.4 | 19.4 | 5.5 | 1078-1111 SB<br>1081-1109 NB<br>Exit 1 SB on/off-ramp | 1083 SB<br>1089 NB | 1095 SB<br>1096 NB | 72 % | 23 % |
| Porcupine Brook | 2,500 | 22.0 | 0.9 | 52.0 | 2.1 | 1111-1234 SB<br>1109-1234 NB<br>Exit 2 SB ramp area | 1129 SB<br>1138 SB<br>1152 SB<br>1165 SB<br>1182 NB<br>1216 NB | 1120 NB<br>1132 NB | 86 % | 14 % |
| South Tributary to Canobie Lake | 165 | 10.6 | 6.4 | 10.7 | 6.5 | 1234-1260 SB<br>1234-1259 NB | 1240 NB | | >95 % | N/A |
| North Tributary to Canobie Lake | 160 | 7.4 | 4.6 | 8.8 | 5.5 | 1260-1280 SB<br>1259-1281 NB | 1274 NB | NA | >95 % | NA |

## Table 4.4-1 (continued)

| Water Resource | Est. Drainage Area (ac) | Roadway Area: No-Build (acres) | Percent[1] (RA/DA) | Build (4 Lane) (acres) | Percent[1] (RA/DA) | Roadway Stations | Proposed Treatment: Detention Basins | Proposed Treatment: Grassed Swales | Percent Treatment[3]: Detention Basins | Percent Treatment[3]: Grassed Swales |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Tributary to Cobbetts Pond -<br>Dinsmore Brook<br>Exit 3 Area | 200 | 19.2 | 9.6 | 52.0 | 26.0 | 1280-1348 SB<br>1281-1353 NB<br>NH Rte 111 4300'<br>Exit 3 NB-ramps<br>Exit 3 SB –on ramp<br>Exit 3 SB off 2600' | 1305 SB<br>1308 NB<br>1311 NB<br>1313 SB<br>1318 SB | 1321 SB | >95 % | 3 % |
| South Tributary to Golden Brook | 210 | 5.5 | 3.6 | 16.1 | 7.7 | 1348-1387 SB<br>1353-1362 NB<br>Exit 3 SB – off 400' | 1364 SB<br>1373 SB | NA | >95 % | NA |
| North Tributary to Golden Brook | 290 | 9.8 | 3.4 | 14.5 | 5.0 | 1387-1427 SB<br>1362-1418 NB | 1398 NB<br>1403 SB | NA | >95 % | NA |
| South Tributary to Flatrock Brook | 125 | 1.6 | 1.3 | 3.1 | 2.5 | 1427-1456 SB<br>1418-1453 NB | 1432 NB | NA | >95 % | NA |
| North Tributary to Flatrock Brook | 350 | 3.7 | 1.0 | 7.4 | 2.1 | 1456-1473 SB<br>1463-1472 NB | 1474 NB | 1445 SB<br>1446 SB | >65 % | 35 % |
| South Tributary to Beaver Brook | 320 | 5.6 | 1.7 | 14.3 | 4.5 | 1473-1531 SB<br>1472-1532 NB | 1485 NB<br>1507 SB<br>1521NB | 1483 SB<br>1511 SB<br>1520 NB | 72 % | 27 % |
| North Tributary to Beaver Brook | 145 | 4.0 | 2.7 | 8.1 | 5.6 | 1531-1553 SB<br>1532-1554 NB | 1555 SB | NA | >95 % | NA |

## Table 4.4-1 (continued)

| Water Resource | Est. Drainage Area (ac) | Roadway Area: No-Build (acres) | Percent[1] (RA/DA) | Build (4 Lane) (acres) | Percent[1] (RA/DA) | Roadway Stations | Proposed Treatment: Detention Basins | Proposed Treatment: Grassed Swales | Percent Treatment[3]: Detention Basins | Percent Treatment[3]: Grassed Swales |
|---|---|---|---|---|---|---|---|---|---|---|
| Beaver Brook | 16,000 | 19.6 | 0.1 | 38.8 | 0.2 | 1553-1627 SB<br>1554-1633 NB<br>Exit 4NB on/off ramp<br>Exit 4 SB on-ramp<br>NH Rte 102 1370' | 1571 SB<br>1583 SB<br>1599 NB<br>1606 SB | 1617 NB | >95 % | 4 % |
| Tributary to Wheeler Pond formerly Pillsbury Rd. Tributary | 550 | 15.1 | 3.2 | 34.5 | 6.3 | 1627-1721 SB<br>1633-1720 NB | 1632 NB<br>1635 SB<br>1650 NB<br>1671 NB<br>1711 SB | 1701 SB<br>1704 SB | 83% | 17% |
| Hoods Pond Tributary - near Stonehedge Rd | 320 | 4.9 | 1.5 | 9.7 | 3.0 | 1721-1749 SB<br>1720-1746 NB | 1733 NB | NA | >95 % | NA |
| Tributary to Little Cohas Brook | 520 | 18.1 | 3.5 | 32.5 | 6.2 | 1749-1813 SB<br>1746-1812 NB<br>Exit 5 on/off ramps<br>3100 ft of NH 28 | 1763 NB<br>1799 NB<br>1804 SB | Sta 111<br>NH 28 | >95% | 5% |
| Cohas Brook | 5,000 | 38.6 | 0.8 | 72.9 | 1.4 | 1813-2021 SB<br>1812-2009 NB | 1842 SB<br>1847 SB<br>1884 NB<br>1885 SB<br>1912 NB<br>1943 NB<br>1995 NB | 1923 SB<br>1935 SB<br>1948 SB<br>1950 SB<br>1960 SB<br>1965 SB<br>1990 SB | 80% | 20% |

## Table 4.4-1 (continued)

| | Roadway Area | | | | | | Proposed Treatment | | Percent Treatment[3] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Resource | Est. Drainage Area (ac) | No-Build (acres) | Percent[1] (RA/DA) | Build (4 Lane) (acres) | Percent[1] (RA/DA) | Roadway Stations | Detention Basins | Grassed Swales | Detention Basins | Grassed Swales |
| Long Pond Brook | 370 | 5.3 | 1.4 | 10.5 | 2.8 | 1911-1969 NB | 1943 NB | NA | >95% | NA |
| Tributary to Cohas Brook | 195 | 8.6 | 4.4 | 10.8 | 5.5 | 1990-2009 NB | 1995 NB | NA | >95% | NA |

1 Estimated percentage of I-93 roadway area within the drainage area based on the preliminary design of the 4-lane alternative.
2 Spickett River is not actually crossed by the I-93 roadway but its watershed includes roadway area within the drainage areas associated with Harris Brook, Policy Brook, Tributary to Harris Brook, Tributary to Porcupine Brook, and Porcupine Brook
3 Indicates proposed roadway station location for treatment measure.
4 Percentage of new and reconstructed I-93 roadway area proposed to be treated by a detention basin and/or grassed swale.
NA Not applicable.
RA Roadway area.
DA Drainage area.

The proposed detention basins will not only be designed for water quality treatment but will provide peak flow control as well. Peak flow control is more crucial in some areas relative to others and could particularly important in the Policy Brook watershed in the southern end of the project area. The residential neighborhood in the Town of Salem, south of Exit 1 and east of I-93 along Haigh Avenue, has experienced flooding problems during large storm events due to rising waters from both Policy Brook and the Spickett River. The preliminary drainage design indicates that runoff from most of the northbound lanes in this area will be diverted to a detention basin on the southbound side due to the lack of available area on the northbound side. This basin will not only provide peak flow control, but would also result in a substantial reduction in the amount of I-93 roadway area draining directly to Policy Brook compared to that under the No-Build Alternative. It is anticipated that the collection of runoff along the northbound lanes will be accomplished through a drainage swale along the shoulder embankment, built in conjunction with a possible berm that would be created to support a noise barrier.

### Phosphorus Loading to Lakes

The phosphorus loading analysis focused on the two principal lakes in the study area, Canobie Lake and Cobbetts Pond. Both of these lakes are extensively used for recreation purposes and Canobie Lake is used as the primary water supply for the Town of Salem. Both lakes are being monitored by volunteer lake monitoring groups and area residents. They have expressed concerns about worsening algal growth and increased nutrient contributions. Substantial increases in phosphorus loading to these lakes could have noticeable impacts to the primary uses of these water bodies.

Sampling conducted by the volunteer groups indicate that the average phosphorus concentration in the surface waters of both lakes is around 9.0 and 10.0 ug/l (micrograms per liter or parts per billion) for Cobbetts Pond and Canobie Lake, respectively. Stream flow inputs into both lakes are minimal with both lakes having only one or two intermittent streams as main surface water inflow. However, both lakes have a fair amount of existing I-93 roadway and other paved surfaces in their watersheds. Canobie Lake has approximately 6,500 linear feet or roughly 18.0 acres of I-93 roadway in its watershed. Except for a small roadway section (i.e., approximately 1,300 feet) near the Windham/Salem town line that drains to Porcupine Brook, most of the I-93 roadway between Brookdale Road and Exit 3 drains to one of two intermittent streams that originate just west of I-93 and empty into Canobie Lake. Much of the Exit 3 northbound off and on ramps are also considered to be in the Canobie Lake watershed. Nearly 4,500 linear feet of existing NH 111 between Exit 3 and NH 28 is also in the watershed. Under the proposed Four-Lane Alternative, the northbound lanes would be shifted to the west by nearly 700 feet in most locations, which moves portions of the I-93 roadway, near Exit 3, and much of the relocated northbound on- and off-ramps, out of the Canobie Lake watershed. In addition, with the construction of a proposed noise barrier along the northbound lanes, drainage from approximately 1,900 feet of roadway located south of the town boundary will be directed to the Porcupine Brook watershed through a closed drainage system. Thus, the I-93 pavement area is estimated to only increase by about 1.5 acres within the watershed. Runoff from all new and reconstructed I-93 roadway area within the watershed will be directed to one of two proposed extended-detention basins. Extended detention basins will also be utilized to treat drainage from the proposed park and ride facility near Exit 3. The expected benefits of these treatment measures are included in the results of phosphorus loading analysis.

A similar amount of existing I-93 roadway area drains to Cobbetts Pond with an estimated 7000 linear feet or roughly 12 acres associated with the northbound and southbound lanes from a point just south of Exit 3 northward and another 1.5 acres associated with the Exit 3 southbound on and off ramps. Much of this roadway drains to Dinsmore Brook, which flows through the Exit 3-Interchange area and outlets in the northwest corner of Cobbetts Pond. In addition, about 6,000 linear feet of the existing NH 111 is in the Cobbetts Pond watershed, which is included in this analysis since it is planned for reconstruction as part of the Exit 3 improvements. Under the proposed project, the amount of roadway area in this watershed is expected to increase by approximately 32 acres with the Four-Lane Alternative. As many as six extended-detention basins are being proposed to treat all of the new and reconstructed roadway area associated with the I-93 and Exit 3-Interchange area. Two grassed swales are also being proposed to treat runoff from the westerly portions of the reconstructed NH 111 roadway area within the Cobbetts Pond area.

As mentioned earlier, the in-lake phosphorus concentrations associated with highway runoff from the existing roadway, as well as the potential changes that may occur under the proposed Four-Lane Alternative, were estimated using a modification to the Vollenweider model as presented by FHWA (Driscoll 1990). The initial phosphorus concentration in runoff was assumed to be 0.4 mg/l, which is considered to be conservatively high, and represents the median concentration that was observed in 50 percent of urban highway sampling locations. The concentration was assumed to be the same under both existing and proposed conditions since the primary source is linked to atmospheric deposition and is not expected to change as a result of the project. The primary change will be reflected in the total phosphorus load as a result of the increased runoff volumes. The model procedure is suitable to project the relative change between existing and proposed conditions attributable to highway runoff, but does not account for other sources that may contribute to future in-lake phosphorus concentrations.

Table 4.4-2 presents the results of the phosphorus loading analysis for each lake under existing and proposed conditions with various treatment effects factored in. The results indicate that under existing conditions highway runoff may potentially contribute as much as 17 to 25 percent of the total phosphorus concentration in both Canobie Lake and Cobbetts Pond. Without accounting for the effects of the proposed treatment measures, the analysis indicates that in-lake phosphorus concentrations could increase by 1.0 and 2.1 ug/l in Canobie Lake and Cobbetts Pond, respectively, with the additional roadway area proposed under the Four-Lane Alternative. As much as 37 to 48 percent of the in-lake phosphorus concentration could be attributable to highway runoff assuming no additional increase from other sources.

**Table 4.4-2**
**Comparison of the Estimated In–Lake Phosphorus Concentration (ug/l) Attributable to Highway Runoff From I-93 with the Total In–Lake Phosphorus Concentration Under the Various Project Alternatives**

| | Canobie Lake | | | Cobbetts Pond | | |
|---|---|---|---|---|---|---|
| Alternative | Highway Runoff (ug/l) | Total Conc.(ug/l) | % total | Highway Runoff (ug/l) | Total Conc.(ug/l) | % total |
| No-Build | 1.7[1] | 10.0[2] | 17% | 2.3[1] | 9.0[2] | 25% |
| Build Alternatives w/out treatment | 3.7 | 11.0 | 24% | 4.4 | 11.1 | 39% |
| Build Alternative w/ Detention Basin (60 % Removal) | 1.1 | 9.4 | 11.8% | 2.6 | 9.3 | 28% |
| Build Alternative w/ Grassed Swale (20 % Removal) | 2.1 | 10.5 | 20% | 3.8 | 10.5 | 36% |

1 Represents the portion of the estimated in-lake phosphorus concentration attributable to runoff from the I-93 roadway.
2 The total concentration represents the existing in-lake phosphorus concentration as provided from existing data plus any future increase as predicted by the model under future conditions.

With the treatment effects of the proposed extended-detention basins, the in-lake phosphorus in Canobie Lake is estimated to decrease slightly while in Cobbetts Pond the in-lake phosphorus concentration is projected to increase slightly. The slight decrease projected for Canobie Lake is due in part to the proposed shifting of the northbound and southbound lanes resulting in slightly less roadway in the watershed area, including both the northbound on and off-ramps. This results in a slight increase in the amount of roadway area within the Cobbetts Pond watershed.

Nonetheless, the results indicate that, with the proposed detention basins. the proposed project, with the Four-Lane Alternative, would result in minimal increase in phosphorus loadings to either lake and, therefore, essentially no resulting impact. Canobie Lake may actually benefit to some degree with the proposed project alternatives, especially with the "tight-shift" design alternative. For Cobbetts Pond, the proposed water quality treatment measures are expected to keep future phosphorous loadings to near existing levels. There may be additional opportunities to treat runoff from other roadway areas, particularly along the existing NH 111, and could be directed to the proposed detention basins or possibly additional detention basins. This would need to be evaluated further as part of final design. As discussed earlier, the detention basins would be constructed in accordance with the NHDES design guidance for water quality treatment.

## Road Salt Impact

Table 4.4-3 presents the results of the road salt impact analysis with estimated roadway lane miles, average annual chloride application (tons), and average annual chloride concentrations (mg/l) for each stream within the project area. Under the No-Build Alternative, with the current deicing application rates, none of the streams are estimated to have average annual chloride concentrations above the aquatic life criteria of 230 mg/l for chloride. As expected, the smaller tributary streams that generally have watershed areas of about 200 acres or less have some of the higher projected concentrations including the north and south tributaries to Canobie Lake and the northeast tributary to Cobbetts Pond. The projected chloride concentrations under the No-Build Alternative range from about 85 to 108 mg/l. These estimated concentrations are well below NHDES's secondary drinking water standard of 250 mg/l for chloride related to problems associated with taste. During sampling efforts conducted in the 1994, the UNH Biology Group had observed high conductivity readings within the inlet cove associated with the north tributary to Canobie Lake (J. Schloss, Pers. Comm., March 2002). High conductivity readings are generally indicative of high sodium and chloride ions in the water column.

Under the Four-Lane Alternative, the average annual chloride concentrations are projected to more or less double in most streams consistent with the fact there would be twice as many travel lanes within most of the watersheds. However, none of the projected average annual chloride concentrations exceed the acute aquatic life standard and secondary drinking water standard of 230 and 250 mg/l, respectively. The highest future concentrations are projected in for the northeast tributary to Cobbetts Pond followed by the north tributary to Canobie Lake. This may present a concern with increased density-stratification within each of the lakes. In the larger streams, where there is substantial aquatic habitat and fish populations, such as the Spickett River, Beaver Brook and Cohas Brook, the projected chloride concentrations are quite low relative to the aquatic life criteria.

There are numerous detention basins and grassed swales being proposed to treat runoff with the Build Alternatives, and although they are fairly effective for various contaminants contained in runoff, they have little effect on sodium and chloride ions because such ions dissolve in water and essentially travel with the water. Runoff diversion is often used as a possible solution to reducing the sodium and chloride inputs. As discussed earlier, approximately 1,900 feet of the proposed roadway will be diverted out of the Canobie Lake watershed and into the Porcupine Brook watershed. However, the opportunities to divert runoff out of the Cobbetts Pond watershed are limited, except for possibly portions of NH 111, west of the Exit 3 Interchange.

**Table 4.4-3**
**Comparison of Estimated Average Annual Chloride (Cl) Concentrations in Each Stream Under the No-Action and Four Lane Build Alternative**

| | | No-Build Alternative | | | | Build-Alternative (4-lane) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Water Resource | Drainage Area | Road Area | Annual Cl Load | Dilution Volume | Chloride Conc.[2] | Road Area | Annual Cl Load | Dilution Volume | Chloride Conc.[2] |
| Units | Acres | Ln-miles | Tons | ac-ft | mg/l | Ln-miles | tons | ac-ft | mg/l |
| Spickett River[1] | >40,000 | 20.2 | 254 | 70000 | 2.7 | 41.1 | 518 | 70000 | 5.4 |
| Policy Brook | 3,500 | 4.3 | 54 | 6125 | 6.5 | 8.6 | 108 | 6125 | 13.0 |
| Trib to Harris Brook | 320 | 3.0 | 38 | 560 | 49.7 | 6.0 | 76 | 560 | 99.3 |
| Trib to Policy Brook (Exit 1) | 350 | 3.6 | 45 | 613 | 54.5 | 4.4 | 55 | 613 | 66.6 |
| Porcupine Brook | 2,180 | 4.0 | 50 | 3815 | 9.7 | 8.0 | 101 | 3815 | 19.4 |
| South Trib to Canobie Lake | 165 | 1.6 | 21 | 289 | 56.0 | 2.9 | 36 | 289 | 116.0 |
| North Trib to Canobie Lake | 160 | 2.6 | 33 | 280 | 87.7 | 5.3 | 67 | 280 | 175.5 |
| Trib to Cobbetts Pond-Dinsmore Brk - Exit 3 | 200 | 4.1 | 51 | 350 | 107.8 | 8.2 | 1032 | 350 | 217.2 |
| South Trib to Golden Brook | 210 | 1.8 | 23 | 368 | 45.4 | 3.8 | 48 | 368 | 95.9 |
| North Trib to Golden Brook | 290 | 3.7 | 46 | 508 | 67.0 | 7.3 | 92 | 508 | 134.1 |
| South Trib to Flatrock Brook | 125 | 1.9 | 24 | 219 | 80.5 | 3.8 | 47 | 219 | 159.3 |
| North Trib to Flatrock Brook | 350 | 1.6 | 21 | 613 | 25.1 | 3.3 | 42 | 613 | 49.9 |
| South Trib to Beaver Brook | 320 | 2.8 | 35 | 560 | 46.7 | 5.7 | 72 | 560 | 94.8 |
| North Trib to Beaver | 145 | 1.6 | 21 | 254 | 60.6 | 3.3 | 42 | 254 | 121.3 |
| Beaver Brook | 16000 | 7.6 | 96 | 28000 | 2.5 | 15.2 | 192 | 28,000 | 5.0 |
| Trib to Wheeler Pond | 550 | 4.9 | 62 | 963 | 47.2 | 9.8 | 123 | 963 | 94.4 |
| Hoods Pond Trib. | 320 | 4.8 | 60 | 560 | 79.5 | 9.6 | 121 | 560 | 158.9 |
| Trib to Little Cohas Brook | 520 | 7.8 | 98 | 910 | 79.5 | 15.6 | 196 | 910 | 158.9 |
| Long Pond Brook | 370 | 4.1 | 52 | 648 | 58.7 | 8.2 | 103 | 648 | 117.4 |
| Cohas Brook | >5,000 | 8.0 | 101 | 8750 | 8.5 | 16.0 | 202 | 8750 | 17.0 |
| Tributary to Cohas Brook | 195 | 1.4 | 18 | 341 | 39.1 | 2.9 | 36 | 341 | 78.2 |

1 No direct runoff to Spickett River. Estimated loading includes contributions to Harris Brook, Policy Brook, and Porcupine Brook.
2 No treatment of sodium chloride is anticipated with the use of the proposed extended detention basins.

The use of alternative decicers as a possible means of reducing sodium and chloride inputs to Cobbetts Pond or Canobie Lake is not a viable solution. This possible remedy would only trade one potential problem for another. Most of the non-chloride based deicers, which are typically produced from organic, grain based or acetate based materials (e.g., Calcium Magnesium Acetate, Potassium Acetate) have been found to contain high levels of nutrients and/or oxygen-demanding substances, and can present other major water quality concerns for downstream lakes and ponds (Transportation Research Board 2001).

For both Canobie Lake and Cobbetts Pond, much of the annual inflow is considered to be from groundwater discharge. The added sodium and chloride contributed by the intermittent streams as a result of the proposed project would be expected to be diluted substantially by the groundwater inflow.

### Summary

There are twenty-one different streams and rivers that were identified within the project corridor, which extends for nearly 20 miles from the Massachusetts border to the I-93/I-293 Interchange in the City of Manchester. There are two relatively large rivers in the study area (Spickett River and Beaver Brook) with watershed areas of well over 10 square miles. There are also several moderately-sizes streams including Policy Brook, Porcupine Brook and Cohas Brook with estimated watershed areas of roughly 3 to 10 square miles. The remaining streams are considered to be small headwater or tributary streams with estimated watershed areas of less than 600 acres or 1.0 square mile. Many of these small streams are considered to support limited or no year-round flow and limited aquatic habitat. All of the streams are classified as Class B waters, except for Canobie Lake. Canobie Lake is a Class A water body because of its use as a public water supply. None of the streams are considered suitable for supporting native cold water fisheries, although Cohas Brook has been stocked on an annual basis with trout species downstream of the project area. All of the identified streams and rivers are currently affected to some degree by highway runoff from I-93 as well as other roadways and developed areas.

The project corridor also includes two important lakes, specifically Canobie Lake and Cobbetts Pond. Both are located primarily in the Town of Windham and just south of the Exit 3 Interchange. Both lakes are extensively used for recreation purposes and Canobie Lake serves as the primary public water supply source for the Town of Salem. These lakes have shown signs of increased algal growth, reduced water clarity and a decline in dissolved oxygen levels in the bottom layers. This trend is presumably due to increased nutrient inputs, especially phosphorus, as a result of existing and increased development within the watershed and runoff from paved surfaces including the I-93 roadway.

As a worst-case assumption, it may be reasonable to assume that the pollutant contributions from highway runoff could be twice as high under future conditions, similar to the amount of new roadway area. However, the preliminary drainage design indicates that runoff from nearly all of the new and reconstructed roadway area could be directed to either an extended-detention basin and/or grassed swale for water quality treatment. Properly designed extended-detention basins and grassed swales have been shown to provide average pollutant removal efficiencies of 60 and 20 percent, respectively, for settleable pollutants and those that travel with particulates. With the current design objective of treating runoff from all of the new and reconstructed pavement area through the use of extended-detention basins, this should result in a 20 percent reduction in the existing theoretical pollutant load associated with highway runoff. This would result in a substantial water quality benefit for the area water resources.

Project-wide, the preliminary drainage analysis indicates that as many as fifty extended-detention basins and twenty four grassed swales could be constructed at various locations along the project corridor. In at least thirteen watersheds, more than 95 percent of the roadway area could be treated by extended-detention basins. This includes several key watersheds including the north tributary to Canobie Lake and the northeast tributary to Cobbetts Pond and Beaver Brook. In these watersheds, as mentioned above, a net reduction in the pollutant load attributable to highway runoff is anticipated in comparison to the No-Build Alternative.

In four (4) other watersheds, extended-detention basins are being proposed to treat more than 80 percent of the roadway area. Grass swales would be used to treat runoff from the remaining portions of the roadway area. In these watersheds, no substantial increase in the pollutant load is anticipated relative to the No-Build Alternative. In three watersheds including the tributary to Porcupine Brook at Exit 2, the north tributary to Flatrock Brook and the south tributary to Beaver Brook, 65 to 73 percent of the total roadway area is currently proposed to be treated by extended–detention basins. Grass swales would be used treat the other remaining portions of the roadway area. In these streams, there is the potential for a slight increase in pollutant contributions from highway runoff based on the conservative assumptions used in this analysis. The level of increase is expected to be minimal and not result in any measurable impacts. Spickett River is also expected to have minimal water quality impacts as a result of the extensive treatment measures being proposed for its tributaries.

As a result of the proposed treatment and possible shifting of the roadway near Exit 3, the phosphorus loading analysis showed a potential slight decrease in the in-lake phosphorus concentration in Canobie Lake, while the projected phosphorus concentration on Cobbetts Pond would increase slightly above existing conditions. The average annual sodium and chloride concentrations in the area streams are expected to increase in proportion to the number of lane-miles within each watershed. However, none of the estimated sodium and chloride concentrations under the proposed four-lane alternative are projected to exceed the aquatic life criteria or secondary drinking water standard for chloride. The proposed detention basins and grass swales have little to no effect on reducing the dissolved sodium and chloride ions in runoff. The added sodium and chloride draining to Cobbetts Pond and Canobie Lake may present a concern with regard to density stratification.

#### 4.4.1.4 Mitigation

The use of extended-detention basins and grassed swales for water quality treatment will be included in the preliminary design along the entire length of the proposed roadway. Given the results of the analysis, discussed herein, and the level of proposed treatment, 17 of the 21 streams in the project area are anticipated to either have lower or no net increase in pollutant contributions relative to the No-Build Alternative. Four of the remaining streams are considered to have the potential for a slight increase in pollutant loading with the Four-Lane Alternative. These potential increases are considered to be minimal and are not likely to result in any measurable changes in water quality or affect the designated uses of these streams. Additional spill protection measures will be implemented for the roadway area within the Canobie Lake watershed consistent with *NHDES Recommendations for Groundwater Protection Measures For Siting or Improving Roadways*.

Runoff from a section of I-93 roadway between Brookdale Road and the Windham/Salem town line will be diverted out of the Canobie Lake watershed. With this diversion of runoff and the proposed treatment measures, no further surface water mitigation measures are considered necessary. However, the opportunities for runoff diversion in the Cobbetts Pond watershed are limited, except for possibly the westerly portions of NH 111, where runoff might be able to be conveyed further to the west and out of the watershed. This potential diversion would depend on which design alternative is selected and will be evaluated further as part of the final design.

During the construction phase, additional measures may be necessary to prevent eroded sediment from exposed soil areas from washing into Canobie Lake or Cobbetts Pond. Contributions of eroded sediment could convey added phosphorus to the lakes, as well present turbidity concerns. Similarly, given their location within the existing median area, additional measures may be necessary to protect Cohas Brook and Porcupine Brook from eroded sediment during the construction period.

NHDOT has developed a number of design details and construction specifications for various erosion control measures to prevent such impacts during the construction phase. In addition, all contractors are required to develop a Stormwater Pollution Prevention Plan (SWPPP) that are reviewed by NHDOT and regulatory agency personnel and describe specific erosion control and contingency measures to be utilized during the construction phase.

## 4.4.2 Aquatic Life Impacts

Direct impacts to fisheries resources may result from construction that places fill material in water bodies or waterways and causes the loss of habitat. Fisheries resources may also be indirectly affected by transportation improvements due to increased water runoff. Contaminants from highway runoff may also affect water quality, fish reproduction, or fish mortality, particularly in areas of heavy traffic.

Impacts to aquatic life would occur with both the Three-Lane and Four-Lane Alternatives. The linear extent (feet) of impacts to perennial watercourses are described below. Ephemeral (intermittent) watercourses, constructed drainage swales, and the culverts associated with these drainages were not included in this impact analysis. Highway construction or upgrading existing highways, that cross or abut perennial streams, may result in the following direct and indirect impacts to aquatic habitats:

- Stream channelization;
- Loss of bank structural complexity;
- Loss of stream flow complexity (riffles/pools);
- Shading from bridges or loss of shading from clearing;
- Alteration of water temperature;
- Reduction of water quality from highway runoff impacts; and
- Alteration of stream hydrology.

These impacts may result in the loss of aquatic habitat (direct impacts) and decline in the quality of the habitat for fish and other aquatic organisms (indirect impacts). The analysis of direct impacts, for this phase of the study, is based on the number of perennial stream crossings within each segment of the study area (Table 3.4-1). Impacts occur to existing stream crossings and to streams that are located adjacent to the roadway. Indirect impacts have not been specifically identified for each segment, however new crossings have potentially greater impacts on aquatic habitats than widening an existing bridge or lengthening a culvert.

### 4.4.2.1 Impact Methodology

Field investigations were conducted during April 2002 to characterize all existing culvert crossings located within the study area. Culvert crossings were classified as a perennial watercourse, intermittent watercourse or drainage swale. Descriptive data collected at each crossing included channel morphology characteristics, culvert characteristics, general riparian vegetation composition, aquatic organisms observed and detailed sketches illustrating channel cross section and locations of any upgradient stormwater sources. Physical characteristics collected at each crossing included temperature, velocity and sampling for benthic invertebrates, field identified to family level. Results of field investigations and personal communications with NHF&GD personnel indicate that although fish are present in most of the perennial watercourses and possibly in portions of some intermittent watercourses, no watercourses in the study area, at least in impacted areas, currently provide high quality fish habitat. The majority of watercourses in the study area exhibit evidence of substantial sedimentation and embeddness.

In an attempt to quantify impacts to aquatic life in streams and provide some comparison between alternatives and options, the potential impact of each alternative on perennial watercourses was determined by calculating the difference in length of the existing and proposed culvert/bridge crossing for each perennial watercourse affected by construction. First, AutoCAD drafting software was used to determine the existing headwall location for each perennial watercourse. Once the headwall location was identified, the edge of disturbance was overlain onto the mapping. The linear distance from the existing headwall to the proposed edge of disturbance was calculated, defining the linear impact (loss of channel substrate) to each perennial watercourse. Given that in every case the perennial watercourse passes through a culvert under the highway, the impact is a measurement of extending the culvert. As such, the impact to aquatic life is considerably less than if a proposed crossing were completely new.

### 4.4.2.2 Build Alternatives

Impacts to perennial watercourses associated with each Build Alternative are described below by highway segment. Table 4.4-4 summarizes the impacts to each perennial watercourse in each segment (see also **Figure 3.4.1**).

**Table 4.4-4**
**Potential Impacts to Aquatic Habitats**

| Segment | Crossing ID | Existing Length (ft) | Stream Impacts 4-Lane (ft) | Stream Impacts 3-Lane (ft) | Option |
|---|---|---|---|---|---|
| A | 77S | 45 | 21 | 9 | Reconstruct |
| | 77S | 45 | 21 | 9 | Relocate |
| | 77B | 106 | 254 | 242 | -- |
| B | 75N | 102 | 104 | 92 | Reconstruct |
| | 75N | 102 | 104 | 92 | Relocate |
| | 75S | 64 | 131 | 119 | Reconstruct |
| | 75S | 64 | 131 | 119 | Relocate |
| C | 70N | 81 | 81 | 69 | Diamond |
| | 70N | 81 | 81 | 69 | Loop |
| | 70S | 52 | 88 | 76 | Diamond |
| | 70S | 52 | 88 | 76 | Loop |

## Table 4.4-4 (continued)

| Segment | Crossing ID | Existing Length (ft) | Stream Impacts | | Option |
|---|---|---|---|---|---|
| | | | 4-Lane (ft) | 3-Lane (ft) | |
| C. cont. | 68N | 160 | 92 | 80 | Diamond |
| | 68N | 160 | 92 | 80 | Loop |
| | 68S | 146 | 78 | 66 | Diamond |
| | 68S | 146 | 104 | 92 | Loop |
| | 66S | 124 | 289 | 277 | Diamond |
| | 66S | 124 | 336 | 324 | Loop |
| D. | 58N | 139 | 97 | 85 | 1 thru 6 |
| | 58N | 271 | 129 | 117 | 7 thru 9 |
| | 58S | 132 | 84 | 72 | 1 thru 6 |
| | 58S | 271 | 129 | 117 | 7 thru 9 |
| | 56N | 139 | 60 | 48 | 1 thru 6 |
| | 56N | 139 | 0 | 0 | 7 thru 9 |
| | 56S | 175 | 0 | 0 | 1 thru 6 |
| | 56S | 175 | 0 | 0 | 7 thru 9 |
| | 55C | 95 | 136 | 124 | 2, 4, 7 thru 9 |
| | 55C | 95 | 30 | 18 | 1, 3, 5, 6 |
| | 51N | 132 | 68 | 56 | 1 thru 6 |
| | 51N | 132 | 36 | 24 | 7 thru 9 |
| | 51S | 114 | 205 | 193 | 1 thru 4, 7, 8 |
| | 51S | 114 | 320 | 308 | 5, 6 |
| | 51S | 114 | 242 | 230 | 9 |
| | 48S | 95 | 51 | 39 | All Options |
| | 47S | 106 | 80 | 68 | All Options |
| | 47N | 126 | 80 | 68 | All Options |
| | 44S | 118 | 69 | 57 | All Options |
| | 42S | 72 | 44 | 32 | All Options |
| | 42N | 130 | 14 | 2 | All Options |
| | 41N | 106 | 0 | 0 | All Options |
| | 41S | 125 | 77 | 65 | All Options |
| E. | 37N | 246 | 0 | 0 | East and West |
| | 37S | 158 | 29 | 17 | East |
| | 37S | 158 | 42 | 30 | West |
| | 34N | 136 | 77 | 65 | East |
| | 34N | 136 | 80 | 68 | West |
| | 34S | 180 | 2 | 10 | East |
| | 34S | 180 | 17 | 5 | West |

**Table 4.4-4 (continued)**

| Segment | Crossing ID | Existing Length (ft) | Stream Impacts 4-Lane (ft) | Stream Impacts 3-Lane (ft) | Option |
|---|---|---|---|---|---|
| **E.** cont. | 33N | 72 | 121 | 109 | East |
| | 33N | 72 | 144 | 132 | West |
| | 33S | 73 | 147 | 135 | East |
| | 33S | 73 | 136 | 124 | West |
| | 27N | 230 | 123 | 111 | East |
| | 27N | 230 | 100 | 88 | West |
| | 27S | 135 | 72 | 60 | East |
| | 27S | 135 | 121 | 109 | West |
| | 26N | 122 | 30 | 18 | East |
| | 26N | 122 | 98 | 86 | West |
| | 26S | 113 | 96 | 84 | East |
| | 26S | 113 | 0 | 0 | West |
| | 22N | 134 | 107 | 95 | East |
| | 22N | 134 | 8 | 4 | West |
| | 22S | 112 | 63 | 51 | East |
| | 22S | 112 | 39 | 27 | West |
| | 21N | 114 | 124 | 112 | East |
| | 21N | 114 | 57 | 45 | West |
| | 21S | 114 | 19 | 7 | East |
| | 21S | 114 | 86 | 74 | West |
| | 19N | 112 | 28 | 16 | All |
| | 19S | 112 | 56 | 44 | All |
| **F.** | 18N | 120 | 107 | 95 | All |
| | 18S | 136 | 62 | 50 | All |
| | 15S | 150 | 220 | 208 | All |
| | 11N | 117 | 71 | 59 | All |
| | 11S | 128 | 104 | 92 | All |
| | 5A | 126 | 36 | 24 | All |
| | 4C | 147 | 0 | 0 | All |
| | 4E | 75 | 138 | 126 | All |
| | 3N | 148 | 24 | 12 | All |
| | 3S | 110 | 0 | 0 | All |
| | 1A | 1,900 | 1,000 | 1,000 | All |

## Three-Lane Alternative

### Segment A

Two perennial watercourses, the tributary to Harris Brook (77S) and Policy Brook (77B), are crossed or impacted within this segment. Impacts to Policy Brook total 60 feet and occur at the existing bridge crossing. Channel substrate in the impact area consists of predominantly sand, gravel and small cobbles. Overall, the substrate appeared to be at least 40 percent embedded, decreasing viable spawning and rearing habitat. Further, cover objects and overhanging vegetation were minimal, additionally decreasing habitat viability in this portion of Policy Brook. Although the Spickett River is not impacted, impacts occur to Policy Brook, a tributary to the Spickett River.

The Three-Lane Alternative would require realignment of approximately 750 feet of the tributary to Harris Brook (77S). North portions of this watercourse are excavated drainage channel and do not provide fish habitat. The tributary to Harris Brook enters the drainage swale immediately north of Valeska Lane and from this confluence south, functions as a perennial watercourse. Portions north of the confluence function as a drainage swale; standing water was observed in this portion of the swale; no flow was detected and no fish habitat was observed. Therefore, although portions of this channel would be altered, impacts to aquatic life are expected to be minimal because higher quality fish habitat is located in southern portions of this watercourse.

### Segment B

The tributary to Porcupine Brook (75N, 75S) is the only perennial watercourse crossed within this segment. Impacts consist of the loss of 210 feet of channel substrate and marginal fish habitat and range from 570 to 630 feet.

### Segment C

Two perennial watercourses, Porcupine Brook (70N, 70S) and the tributary to Porcupine Brook are located within this segment. Impacts consist of the loss of channel substrate and fish habitat. Impacts from culvert extensions total 570 feet for the diamond option and 640 feet for the loop option.

### Segment D

All Exit 3 options (1 through 9) in Segment D for the Three-Lane Alternative would impact 7 perennial watercourses. Impacted watercourses include the south and north tributaries to Canobie Lake, tributary to Cobbetts Pond, south and north tributaries to Golden Brook, and north and south tributaries to Flatrock Brook. Impacts range from 815 feet to 945 feet.

### Segment E

Four perennial watercourses would be impacted by both the east and west option. Impacted watercourses include the south tributary to Beaver Brook (not impacted along the northbound lane), Beaver Brook, tributary to Wheeler Pond and tributary to Hoods Pond. Three-Lane east option impacts total 935 feet; and Three-Lane west option total 790 feet.

### Segment F

Five perennial watercourses including the south tributary to Cohas Brook, tributary to Little Cohas Brook, Cohas Brook, and the north tributary to Cohas Brook would be impacted. Long Pond Brook would not be affected by any of the relocated or reconstruct options. Impacts to the other watercourses are the same for all three options and total 510 feet for the Three-Lane Alternative.

## Four-Lane Alternative

### Segment A

The Spickett River is not impacted. However, this alternative would require realignment of approximately 750 feet of the tributary to Harris Brook, a tributary to the Spickett River.

### Segment B

The tributary to Porcupine Brook is the only perennial watercourse crossed within this segment. Impacts from culvert extensions total 235 feet.

### Segment C

Two perennial watercourses, Porcupine Brook and the tributary to Porcupine Brook are located within this segment. Impacts from culvert extensions total 630 feet for the diamond option and 700 feet for the loop option.

### Segment D

All Exit 3 options (1 through 9) in Segment D would impact 7 perennial watercourses. Impacted watercourses include the south and north tributaries to Canobie Lake, tributary to Cobbetts Pond, south and north tributaries to Golden Brook, and north and south tributaries to Flatrock Brook. Impacts range from 960 feet to 1,090 feet.

### Segment E

Four perennial watercourses would be impacted by both the east and west option. Impacted watercourses include the south tributary to Beaver Brook (not impacted along the northbound lane), Beaver Brook, tributary to Wheeler Pond and tributary to Hoods Pond. Impacts from the east option total 1,095 feet; the west option impacts total 930 feet.

### Segment F

Five perennial watercourses including the south tributary to Cohas Brook, tributary to Little Cohas Brook, Cohas Brook, and the north tributary to Cohas Brook would be impacted. Long Pond Brook would not be affected by any of the relocated or reconstruct options. Impacts to the other watercourses are the same for all three options and total 580 feet. The only direct impacts to Essential Fish Habitat (EFH) occur at Cohas Brook from a full box culvert replacement. Although a box culvert with a floor will result in impacts to channel substrate and potential fish habitat, conditions at the existing crossing are already degraded. Channel substrate consists of predominantly coarse sands; little vegetation and undercut banks are present. The dynamic substrate provides minimal habitat for aquatic organisms. Additional coordination with NMFS will be performed prior to the FEIS on this issue.

### Four-Lane/Three-Lane Combination

A third alternative is the combination of four lanes beginning at the state line and extending north to Exit 3, where the roadway would narrow to three lanes northward to the I-93/I-293 split located in Manchester. Since the same perennial watercourses are affected by Three-Lane and Four-Lane Alternatives, the Four-Lane/Three-Lane Combination would affect the same perennial watercourses as either alternative constructed separately. The Three-Lane Alternative impacts are slightly lower, due to the narrower cross section of the finished roadway.

### Bike Path

Construction of the bike path with either the Three-Lane or Four-Lane Alternative would result in minor additional amounts of culvert extensions.

### Sound Walls

The sound walls being proposed would not have additional impacts on perennial watercourses or aquatic habitat beyond those already described for the Build Alternatives.

## 4.4.2.3 No-Build Alternative

The No-Build Alternative would not affect aquatic life because no new construction would occur.

#### 4.4.2.4 Mitigation

To the extent that fisheries resources are impacted, mitigation will be in the form of improving water quality through the use of Best Management Practices (BMPs) to treat stormwater runoff and control flow velocities. Where overhanging trees and brush are removed at culvert entrances, and such trees and brush appear to shade fish habitat, landscaping of a similar type will be provided. Lastly, where a culvert's condition requires complete replacement, consideration will be given to enlarging the opening to enhance passage of fish and wildlife. The sizing of replaced culverts will be coordinated with the appropriate resource agencies.

■

### 4.4.3 Groundwater Resources

#### 4.4.3.1 Introduction

The following section presents an analysis of the potential impacts on groundwater resources in the project area as a result of the proposed project. The principal groundwater resources include stratified-drift aquifers and public wells that are located within or adjacent to the project area. As described in Section 3.4.2.1, there are two principal stratified-drift aquifers located at the southern and northern ends of the project area. Neither of these two stratified-drift aquifers are currently being used for drinking water supply purposes. The major impacts of concern relate to the potential reduction in recharge to the aquifer due to increased impervious area and the increased risk of contamination due to various pollutants from land-use activities including the use of road salt for deicing purposes. The analyses described below includes a comparison of existing and proposed roadway area within stratified-drift deposits as well as an evaluation of the potential long-term average annual sodium and chloride concentrations in groundwater at the downgradient edge of the right-of-way.

Public wells in the study area represent the other principal groundwater resource of concern. As described in Section 3.4.2.2, NHDES has several categories of community and non-community public wells and considers roadways and transportation facilities as moderate contamination risks and has developed a guidance document of recommended groundwater protection measures for new or improved roadways that may be within the Wellhead Protection Area (WHPA) or within a certain distance from certain types of public wells. This document provides the basis for assessing groundwater protection needs as it relates to the proposed project and is described further below.

### 4.4.3.2 Groundwater Impact Analysis Methodology

#### Stratified-Drift Aquifers

The amount of I-93 roadway area traversing through identified stratified-drift aquifer areas was estimated for each of the project alternatives using the preliminary design plans (**Figure 3.4-2**). Based on the estimated amount of roadway area within each of the stratified-drift aquifers, a general assessment of the potential effect on groundwater recharge as well as the existing or future use of the aquifer was conducted while considering the inherent characteristics of the aquifer, the availability of an existing municipal water supply system and the existing land use conditions within the aquifer area. The presence of roadway areas in stratified-drift aquifers does not necessarily imply that impacts to groundwater quality will occur such that the stratified-drift aquifers will no longer be viable for existing or future water supplies. In fact, throughout New Hampshire, it is not uncommon for roadways and other types of development to be located in the same sand and gravel aquifer that is being used to supply a community well for drinking water purposes.

#### Potential Sodium and Chloride Impacts from Deicing Activities

Sodium and chloride as components of road salt, which is used to maintain safe travel conditions during the winter season, can pose a potential threat to groundwater used for drinking water because of the high solubility and mobility of sodium and chloride in water and the potential adverse effects on drinking water associated with taste. Currently, NHDES has a secondary drinking water standard of 250 mg/l for chloride and sodium to avoid problems with taste.

The amount of sodium and chloride that potentially enters the groundwater depends on the application rate, the amount of roadway treated and the amount of highway runoff that infiltrates into the soil carrying the sodium and chloride ions. The resulting concentration in groundwater depends on the distance from the roadway, the amount of dilution provided by the groundwater flow and the additional recharge received along the travel path. Using a mass-balance approach, the average annual sodium and chloride concentrations at the downgradient edge of the right-of-way were estimated while accounting for the various hydrogeologic conditions under the No-Build and the proposed Four-Lane Alternative. The Four-Lane Alternative represents the worst case of any of the Build Alternatives.

An infiltration zone was established which corresponds to the distance between the downgradient edge of right-of-way and point 50 feet above the upgradient edge of pavement. On average, the right-of-way width was estimated to be 300 and 400 feet for the existing and proposed build conditions and this includes an average median width of 100 feet, which varies substantially and is much larger in many locations. A worst-case analysis was conducted by assuming all of the applied sodium and chloride infiltrated into the groundwater beneath the infiltration zone with the average annual recharge. In reality, depending on the underlying soil types and drainage infrastructure, much of the applied road salt may be conveyed by surface runoff and end up in nearby surface waters.

The average annual application for road salt was based on an annual rate of roughly 21 tons per lane-mile, which is considered typical for Interstate highways in New Hampshire (NHDOT - Director of Highway Maintenance, 2002). It was also assumed that chloride and sodium comprised 61 and 31 percent of the road salt, respectively. Each mile of I-93 was assumed to consist of 4 and 8 lane-miles under the No-Build and the Four-Lane Alternative, respectively. Again, the analysis focuses on the Four-Lane Alternative, since it represents the worst-case condition.

The average annual recharge entering the infiltration zone was based on the average annual precipitation less evapo-transpiration or approximately 19 inches (Stekl and Flanagan, 1992). The road salt entering the groundwater below the infiltration zone was then diluted by the background groundwater flow passing beneath the infiltration zone. The background sodium and chloride concentrations in groundwater were assumed to be 10 and 19.5 mg/l, respectively, based on the median background levels measured in thirty different monitoring wells located throughout southeastern New Hampshire (Flanagan and Stekl 1992). The groundwater flow rates (acre-feet/year) were based on an estimated mixing depth of 10 feet and estimated groundwater velocities of 10.0, 4.2 and 1.25 feet/day for coarse-grain, fine-grain stratified-drift and glacial till deposits, respectively. These velocities are based on typical permeability, slope and porosity data provided in the USGS reports (Flanagan and Stekl, 1992). Additional dilution that would occur beyond downgradient edge of the right-of-way was not included in this analysis.

### Encroachment on Wellhead Protection Areas for Community Public Wells

An analysis was conducted to determine whether the proposed roadway improvements under the proposed alternatives would encroach upon the Wellhead Protection Areas (WHPAs) associated with the public wells that are within, or adjacent to, the project area as identified by NHDES. NHDES has developed a list of recommended groundwater protection measures or Best Management Practices (BMPs) for new or re-constructed roadways that are within the WHPA of a public water supply well (NHDES 1995). As shown in Table 4.4-5, there are four (4) escalating levels of protection with various recommended BMPs to select from depending upon on the size of well (i.e., production capacity) and distance from the roadway. The BMPs are geared toward protecting the well from contaminants potentially contained in highway runoff as well as from vehicular related spills and include both structural and non-structural measures. The structural measures may include lined grassed swales, and lined snow storage areas (i.e., median and shoulder areas), runoff diversion through closed drainage and raised guardrails to minimize vehicle rollovers. The non-structural measures include providing site-specific drainage information to local hazardous materials response teams. These recommended BMPs were intended to apply only to community and non-transient,

**Table 4.4-5**
**NHDES Recommended Best Management Practices for Groundwater Protection Associated with New or Improved Roadway Construction**

| | Applicability | Recommended measures |
|---|---|---|
| **Level 1** | For all new and improved roadway areas. | Use grassed swales and/or other appropriate stormwater treatment BMPs to treat runoff from roadways, wherever possible. |
| **Level 2** | Any new or improved roadway section that is within the following areas:<br>• Wellhead protection area for community (C) or non-community, non-transient (P) public well;<br>• Locally designated groundwater protection areas;<br>• GA1 designated areas (watersheds or recharge areas to existing or future water supplies)<br>( Exceptions: see below[1] ) | 1) Appropriate storm water treatment BMPs. (i.e., grassed swales, detention ponds, etc.)<br>2) Non-structural measures (Provide site-specific drainage information to local and state emergency spill response officials). |
| **Level 3** | Any new or improved roadway that is:<br>• Within 1000 feet of a large ($\geq$57,600 gpd ) C or P public well<br>• Within 500 feet of a small (<57,600 gpd) C or P well<br>( Exceptions: see below[1] ) | 1) Lined grassed swales.<br>2) Lined snow storage areas (i.e., shoulder and median areas).<br>3) Divert runoff out of the area to the extent possible.<br>4) Higher guard rail to minimize the potential for truck rollovers.<br>5) Reduce salt applications as feasible. |
| **Level 4** | Any new or improved roadway that is:<br>• Within 400 feet of a large ($\geq$57,600 gpd ) C or P public well<br>• Within 200 feet of a small (<57,600 gpd) C or P well | 1) Closed drainage system discharging outside the Level 4 area.<br>2) Higher guard rail to minimize the potential for truck rollovers.<br>3) Non-structural measures (Provide site-specific drainage information to local and state emergency spill response officials). |

1 Exceptions: Recommended measures for a lower level may be used if one of the following conditions apply: (1) the area is also not within a Level 3 or 4 area; (2) there is a competent impermeable layer between the well's screened interval and the road surface or: (3) the bottom of the well is above the elevation of the highway so that the groundwater flow direction is away from the well, or (4) the WHPA of an overburden well does not include the highway or its drainage system.

gpd = gallons per day

non-community public wells. Several site-specific factors should also be considered in selecting the most appropriate protection measures. These factors include whether the aquifer supplying the well is confined and separated from the highway by a competent impermeable layer or the bottom of the well is above the elevation of the highway such that the flow direction is away from the well.

As defined by NHDES, community wells include wells that involve 15 or more service connections or serve more than 25 people of the same people 365 days a year.

These are wells associated with residential properties such as single-family homes, multi-family units including condominiums and apartments and mobile home parks.

The public well locations and associated Wellhead Protection Area (WHPA) information was supplied by NHDES. Although it is not a public well, the Canobie Lake watershed was also included in this analysis, since it is classified as a GA1 zone under the WHPA regulations, which is a recharge or watershed area to a public water supply. The distance to each of the individual wells was determined using the 1 inch equals 400 feet scale preliminary design plans for the Four-Lane Alternative.

### 4.4.3.3 Groundwater Impact Analysis Results

#### Stratified-Drift Aquifers

Table 4.4-6 presents a comparison of the estimated amount of I-93 roadway area within the two primary stratified-drift aquifers in the project area under the various project alternatives (as shown on **Figure 3.4-2**). The roadway area under the Build Alternatives includes the pavement area from both the existing and the proposed roadway area. In the southern stratified-drift aquifer, which extends from the state border north to about midway between Exits 1 and 2, the amount of roadway area associated with the project under the proposed alternatives will increase from about 44.0 acres to 75.0 acres under the Three-Lane Alternative and to about 77.5 acres with the Four-Lane Alternative. There is relatively little difference between the two alternatives south of Exit 1 which accounts for the minimal difference in the estimated pavement area within the aquifer. In the northern stratified-drift aquifer, the amount of I-93 roadway area is estimated to increase by about 34.0 and 45.0 acres under the Three-Lane Alternative and Four-Lane Alternative, respectively. The proposed bikepath and park and ride facilities could add another 16.0 and 13.0 acres of paved area, respectively, in these stratified-drift areas depending on which of the design alternatives is selected. For each of these stratified-drift aquifers, which are estimated to be over 5,000 acres in size, the estimated increase of about 55 to 75 acres of roadway area in each aquifer represents a small percentage of the overall aquifer size.

Most of the southern stratified-drift aquifer is composed of finer-grained material and has shallow depths of less than 20 feet. In addition, a considerable amount of the land area is already extensively developed with commercial properties along Rockingham Park Boulevard, South Policy Street and NH 28. As described in Section 3.4, the Town of Salem has two production wells located about 3,000 feet west of the I-93 roadway, but they have not been used for nearly two decades because of a contamination problem. This aquifer is not considered to be highly favorable for use as a future water supply source given the extent of the existing development, the low production potential and existing contamination problems within this aquifer area. Most of the residences and commercial properties throughout this area are serviced by the Salem municipal water system.

**Table 4.4-6**
**Comparison of I-93 Roadway Area Crossing the Two Stratified-Drift Aquifers in the Project Area under the No-Build and the Build Alternatives**

| Total I-93 Roadway Area (acres) Overlying Each Stratified-Drift Aquifer | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Southern Aquifer Roadway Segment[1]** | | **A** | **B** | | **C** | | |
| | | | **Exit 1** | | **Exit 2** | | |
| **Alternative** | **Transmissivity ($ft^2$/d)[2]** | | **Reconstr.** | **Relocate** | **Loop** | **Diamond** | **Total Acres[3,4]** |
| No-Build | <1000 | 13.3 | 21.3 | | 7.2 | | 41.8 |
| | 1000-2000 | 1.0 | 1.1 | | -- | | 2.1 |
| 3-Lane | <1000 | 21.8 | 32.0 | 36.1 | 13.4 | 13.4 | 71.3 |
| | 1000-2000 | 1.8 | 2.0 | 2.1 | -- | -- | 3.9 |
| 4-Lane | <1000 | 22.6 | 32.5 | 36.6 | 14.4 | 14.4 | 73.6 |
| | 1000-2000 | 1.8 | 2.0 | 2.1 | -- | -- | 3.9 |

| **Northern Aquifer Roadway Segment[1]** | | **E** | | **F** | | | |
|---|---|---|---|---|---|---|---|
| | | **Exit 4** | | **Exit 5** | | | **Total Acres[3,4]** |
| **Alternative** | **Transmissivity ($ft^2$/d)[2]** | **East** | **West** | **Relocate NH 28** | **Recon NH 28** | **Reloc NB NH 28** | |
| No-Build | <1000 | 26.4 | | | 8.6 | | 35.0 |
| | 1000-2000 | 3.9 | | | -- | | 3.9 |
| 3-Lane | <1000 | 49.0 | 47.8 | 17.5 | 16.5 | 17.3 | 66.5 |
| | 1000-2000 | 5.9 | 6.0 | -- | -- | -- | 6.0 |
| 4-Lane | <1000 | 57.2 | 56.0 | 19.8 | 19.3 | 19.7 | 77.0 |
| | 1000-2000 | 6.9 | 6.8 | -- | -- | -- | 6.9 |

Notes:
1 The entire project area consists of Roadway Segments A through F – There are no stratified –drift aquifers in Roadway Segment D.
2 Transmissivity data is based on the USGS Hydrological Investigations (Flanagan and Stekl, 1992). The maximum transmissivity in the project area was 2000 sq. ft./ day.
3 Total acres include the maximum total for all alternatives and the existing roadway area.
4 Total acres does not include approximately 16.0 and 13.0 acres associated with the proposed bikepath and park and ride facilities, respectively, with either the Three-Lane or Four-Lane Alternatives.
-- Indicates no impacts for this transmissivity area.

Nearly all of the existing and proposed roadway area is within the low transmissivity portions of the aquifers. Under all of the alternatives and design options, less than 10.0 acres of roadway area is estimated to be within the medium transmissivity portions of either aquifer (i.e., 1000-2000 $ft^2$/day). One of the most productive portions of the northern aquifer is located within the Beaver Brook river valley just east or upgradient of the I-93 roadway in the West Derry area. The Town of Derry at one time used a production well located in this area, but has not used it since the early 1980's, when they tied into the Manchester Water Works system, which now supplies water for most of the properties along NH 102 and 28.

The comparison of roadway area within stratified-drift aquifers also shows that there are relatively minor differences between the various design options for the interchanges. For Exit 1, the difference between the proposed reconstruction and relocation options would be about 4.1 acres for both the Three-Lane and Four-Lane Alternatives with the relocation option having the higher amount. For Exit 2, there is essentially no difference in the amount of roadway area in the stratified-drift aquifer in comparing the Loop option with the Diamond option. For Exit 3, there are no impacts to the northern or southern aquifers as they lie north of, and south of, the interchange area.

In review of the two Exit 4 design options, the westerly relocation option would result in slightly less roadway area (approximately 1.3 acres less) in the stratified-drift aquifer as compared to the easterly relocation option with either the Three-Lane or Four-Lane Alternatives. For the Exit 5 interchange, the difference in estimated roadway area between the three different design options is less than 1.0 acre with either the Three–Lane or Four-Lane Alternative. The relocation of NH 28 would have the highest amount. Again, given the overall size of the stratified-drift aquifer, the extent of the low transmissivity and the limited overall use of the aquifer for water supply, the expected increase in roadway area under the various project alternatives is not expected to result in any measurable adverse impacts to the aquifer. The impacts associated with increased deicing activities are presented in the next section.

### Sodium and Chloride Analysis Results

Table 4.4-7 presents the estimated average annual sodium and chloride concentrations in groundwater at the downgradient edge of the right-of-way for the several types of geologic deposits that exist in the study area under the No-Build and Four-Lane Alternative. The results show that even with the proposed doubling of roadway lane-miles under the Four-Lane Alternative, the average annual sodium and chloride concentrations in groundwater at the edge of the right-of-way along the entire length of roadway are projected to be well below the 250 mg/l secondary drinking water standard for sodium and chloride.

The lowest average annual sodium and chloride concentrations are expected to be in the stratified-drift deposits, because of the greater groundwater flow rates and available dilution. Slightly higher concentrations projected for the fine-grained deposits are due to the lower permeability rates (i.e., 25 and 50 feet/day for the fine-grain and coarse-grain material, respectively), which translates into less dilution from background groundwater flow. In the stratified-drift deposits, the projected sodium and chloride concentrations are roughly 25 to 50 percent higher under the Four-Lane Alternative, depending on the material (Table 4.4-7). The roadway areas that are considered to be within stratified-drift deposits include most of the roadway south of Exit 2 and another section starting just south of Exit 4 and continuing northward to Stonehenge Road, but excluding the Exit 4-Interchange area itself. Much of the Exit 5 roadway area and another short section just north of the

Londonderry/Manchester town line are also considered to overlay stratified-drift deposits.

**Table 4.4-7**
**Estimated Average Annual Sodium and Chloride Concentrations in Groundwater at the Edge of Right-of-Way within Stratified-Drift and Till Deposits under the No-Build and Four-Lane Alternative**

| | No-Build Alternative | Four-lane Alternative |
|---|---|---|
| **Stratified-Drift** | | |
| **Coarse-Grained** | | |
| Sodium (mg/l) | 15.3 | 20.6 |
| Chloride (mg/l) | 27.1 | 35.6 |
| **Fine-Grained** | | |
| Sodium (mg/l) | 22.5 | 34.9 |
| Chloride (mg/l) | 38.4 | 57.8 |
| **Till Deposits** | | |
| Sodium (mg/l) | 48.9 | 86.0 |
| Chloride (mg/l) | 79.4 | 137.2 |

As expected, the projected sodium and chloride concentrations are higher in the till deposits relative to the stratified-drift deposits due to the lower ground water velocities and less available dilution in the till deposits. However, both the future sodium and chloride concentrations are well below the 250 mg/l secondary drinking water standard. It is important to note that in calculating the existing and future concentrations, it was assumed that all of the applied road salt and associated sodium and chloride would infiltrate into the groundwater. In till deposits, in particular, because of the lower infiltration potential, a fair amount of the applied road salt will be conveyed by runoff to surface waters, which would result in lower groundwater concentrations. To be conservative, the surface water impact analysis assumed that all of the applied road salt was conveyed to the surface water resources.

Much of the middle portion of the project area, located between Exits 2 and 4, is underlain by till deposits. Even though the average annual sodium and chloride concentrations are not expected to exceed 250 mg/l beyond the project right-of-way in till deposits, the area that would be considered most susceptible to road salt impacts is the area located downgradient from Exit 3. The residential and commercial properties in this area are all served by community or private wells located in the area. In contrast, the commercial and residential properties located adjacent to Exits 2 and 4 are primarily serviced by municipal water supply systems and represent less of a concern with respect to road salt impacts.

NHDOT does maintain a Well Replacement Program that would investigate and implement remedial measures, as necessary, if any private or public wells were found to be impacted due to NHDOT's highway maintenance or construction activities. In addition, with respect to certain public wells, various groundwater protection measures and roadway drainage modifications will be included into the final roadway design, consistent with NHDES Recommendations for Groundwater Protection Measures for Siting and Improved Roadways, as discussed below. Future sodium and chloride concentrations will likely be lower than that projected depending on the type of groundwater protection measures utilized and the distances from the roadway.

### Encroachment on Wellhead Protection Areas (WHPAs) Associated with Public Wells

Table 4.4-8 presents the relevant public wells, their associated WHPA radius and the estimated distance from the new roadway to each well and the amount of roadway within the WHPA limits. The public well locations and associated WHPA radius are based on the public well location maps provided by NHDES for the project area (April 3, 2002). The estimated distances from the roadway are based on the No-Build and the Four-Lane Alternatives to represent a worst-case analysis. The public wells listed as inactive by NHDES were not included in this analysis.

Of the twelve active public wells in the project area, seven have established WHPAs with a protective radius ranging from 1200 to 4000 feet. The wells that have established WHPAs correspond to four community wells servicing residential properties and three non-community, non-transient wells serving businesses or day care facilities. NHDES as a general policy has not established WHPAs for non-community, transient wells. With respect to the estimated distance between roadway and the identified public wells, as many as five wells located near the Exit 3 Interchange, would have greater separation distance from the roadway under the proposed Four-Lane Alternative based on the selected design option and the resulting roadway alignment through the interchange area. The largest increase could occur with the Pennichuck Water Works wells where the northbound lanes would be shifted from about 400 feet to 1150 feet away from the wells under the proposed "tight shift" alignment. This would result in a positive impact to the wells allowing for greater separation distance and added protection to the wells with regard to accidental spills. Without the "tight-shift" option, the new roadway would remain about 400 feet from the Pennichuck community wells.

With the proposed Exit 3 improvements, three other wells could also be further away from the newly constructed I-93 mainline and associated ramps. The proposed

**Table 4.4-8**
**Estimated Amount of WHPA Encroachment for Public Water Supply Wells Located Within the Project Area**

| | | | | No-Action | | Build (4-lane) | |
|---|---|---|---|---|---|---|---|
| Well No.[1] | Facility Name | WHPA Radius[2] | System Type[3] | Distance From Roadway (feet) | Roadway in WHPA (lane-miles) | Distance From Roadway (feet) | Roadway in WHPA (lane-miles) |
| 2 | Pennichuck Water Works (2 wells) West Shore Rd. | 4000 ft | C | 400 | 5.8 | 1150 | 10.8 |
| 4 | Semiconductor Circuits, Inc. NH 111 | 1200 ft | P | 1900 | None | 2700 | None |
| 5 | Sisters of Mercy –Searles Castle Property 21 Searles Road | 2000 ft | C | 1500 upgradient | 2.10 | 2100 upgradient | 1.90 |
| 6 | Citizens Bank 115 Indian Rock Rd. | NA | N | 300 | NA | would be acquired | NA |
| 7 | Plaza 93-Dunkin Donuts NH 111 | NA | N | 400 | NA | would be acquired | NA |
| 8 | Castleton Banquet Facility 92 Indian Rock Rd | NA | N | 300 | NA | 800 | NA |
| 9 | Early Years Kindergarten 71 Indian Rock Rd. | 1300 ft | P | 1800 100 (NH 111) | 0.94 | 1800 180 (NH 111) | 1.88 |
| 10 | McCauley Common Condos 37 Searles Rd. | 2000 ft | C | 1200 upgradient | 2.34 | 1160 upgradient | 4.68 |
| 11 | Taylors Cntry Day Care 125 North Lowell Road | 1300 ft | P | 800 | 1.70 | 760 | 3.4 |
| 12 | Taylors Ballroom 122 North Lowell Road | Na | N | 1000 | NA | 960 | NA |
| 13 | Go-Go Mart 132 North Lowell Road | Na | N | 1000 | NA | 960 | NA |
| 14 | Boumil Grove Condos 1 Charleston Avenue | 1500 ft | C | 500 | 1.60 | 460 | 3.2 |

1 Well No. represents the map numbers presented in **Figure 3.4-2**.
2 WHPA radius as measured from NHDES public well location maps (April 3, 2002).
3 System type refers to:
C=Community well serving residential customers or buildings (i.e., homes, condominiums, mobile homes, etc.)
P=Non-community, non-transient supply well serving 25 or more of the same people at least 180 days of the year ( i.e., businesses, day-care, schools, etc.).
N=Non-community, transient supply wells serving 25 or more different people at least 60 days of the year (i.e., restaurants, motels, campgrounds, etc.).
[4]NA =Not applicable for non-community, transient wells or inactive well systems.

southbound on-ramp would be an additional 300 to 500 feet away from the well that serves the Castleton facility and with the “tight-shift” option the I-93 mainline could be about 900 feet away instead of about 600 feet from the facility under existing conditions. With any of the Exit 3 Interchange design options, the wells serving the Searles Castle property well and the Semiconductor Circuits facility would also be several hundred feet further away from the new I-93 mainline location. However, the added distance would represent a limited benefit, since both wells are already (and will continue to be) upgradient of the I-93 roadway.

The proposed options for reconstructing or relocating the section of NH 111, west of the Exit 3 interchange, will have differing effects on the distance and the juxtaposition of the new roadway relative to the public well serving the Early Years Kindergarten located on NH 111 on Windham. Currently, the NH 111 roadway is about 150 feet south of the Kindergarten well, but is considered down-gradient of the facility. The groundwater is assumed to flow in a north to south direction towards Cobbetts Pond. With the reconstruction option, the new NH 111 roadway section would be slightly closer, but would remain downgradient of the facility. Under the relocation option, the new roadway would be located about 150 feet north of the facility, essentially upgradient of the facility. This upgradient location may pose a greater risk to the well even though the new roadway would be about the same distance from the well. Neither design option would substantially affect the distance from the I-93 roadway, which will still be about 2000 feet away and outside the 1200 feet WHPA radius.

Under any of the proposed Exit 3 Interchange improvements, two business facilities serviced by their own wells, referred to as the Yankee Trader property and the Plaza 93, are proposed to be acquired due to the proposed shifting of the roadway and, therefore, the use of the wells would be eliminated as well.

For the remaining five public wells that are located north of the Exit 3 Interchange, the proposed highway footprint, under the proposed Four-Lane Alternative, will be slightly closer to each well by about 40 feet. This accounts for the additional pavement width associated with the two additional travel lanes plus the additional shoulder width. The community well serving the Boumil Grove Condominiums in Londonderry (just south of Exit 4) will be closest to the proposed roadway at an estimated distance of 460 feet as compared to 500 feet under existing conditions.

In terms of the total amount of I-93 roadway area (lane-miles) within the WHPA, the community wells owned by Pennichuck Water Company will have largest amount with an estimated 10.8 lane-miles under the proposed Four-Lane Alternative as compared to 5.8 lane-miles under the No-Build Alternative. Although the number of lanes will double, the increase in roadway area in the WHPA is not quite double because several hundred feet of the roadway will be shifted out of the WHPA at both the northerly and southerly limits of the WHPA. The community well servicing the McCauley Common Condos has the second largest amount of the roadway area within the WHPA with an estimated 2.3 and 4.7 lane-miles in the WHPA under the No-Build and Four-Lane Alternative, respectively. However, this well is located upgradient of the I-93 roadway location similar to the well servicing the Searles

Castle property. The wells that supply both Taylors Country Day Care and the Boumil Grove Condos have the next largest and similar amounts of I-93 roadway area in the WHPA with 1.6 to 1.7 lane-miles under the No-Build Alternative and about 3.2 to 3.5 lane-miles under the Four-Lane Alternative. The only other public well with an established WHPA relates to the Early Years Kindergarten Facility, which has no I-93 roadway area in its WHPA, but has about 0.9 and 1.8 lane–miles of NH 111 roadway area under the No-Action and proposed Four-Lane Alternative, respectively.

According to the NHDES Recommendations for Groundwater Protection Measures for New and Improved Roadways, there are two community and two non-community, non-transient wells that may warrant higher than Level 1 protection measures (see Table 4.4-5). The well serving the Boumil Grove Condominiums in Londonderry may warrant Level 3 protection measures since this small community well will be within 500 feet of the proposed new or reconstructed roadway, regardless of the proposed alternative. The well is downgradient of the highway and is located in a sand and gravel aquifer with no known impermeable layers. As an alternative, it may be possible to connect to the municipal water system since a new water main appears to have been recently installed within 500 feet of the condominium location.

In addition, the community wells owned by the Pennichuck Water Company along West Shore Drive near Canobie Lake may also require Level 3 protection measures depending on which Exit 3 Interchange design option is selected. Under the "tight-shift" alternative, the I-93 mainline would be relocated more than 1,000 feet away from the wells, which would indicate that Level 2 measures would be appropriate. Otherwise, without the "tight-shift" alternative, then Level 3 protection measures should be considered, since the reconstructed roadway would be within 500 feet of the wells. Due to the large WHPA radius associated with the Pennichuck wells (i.e., 4,000 feet), the added costs associated with the Level 3 structural measures could be substantial since it would involve upwards of 8,000 feet of roadway, as well as the Exit 3-Interchange area. The proposed park and ride facility at Exit 3 will also be within the WHPA of the Pennichuck Well. It is worth mentioning, however, that the proposed diamond ramp configuration with increased de-acceleration distances, particularly with the southbound off-ramp, is expected to substantially reduce the potential for truck rollovers and any associated spills, relative to the existing loop-ramp configuration.

The primary differences between Level 2 and Level 3 protection measures is that under Level 3, NHDES recommends the use of impermeable materials in the lining of drainage swales and median areas to reduce the infiltration of sodium and chloride into groundwater, the diversion of runoff outside of the WHPA to the extent feasible, and the use of raised guard rails, where appropriate, to reduce the potential for truck rollovers and related spills, as well as possibly reducing road salt applications. As previously discussed, these are in addition to Level 2 measures, which include the use of appropriate stormwater treatment measures and coordination with the local hazardous materials spill response personnel to insure they have sufficient site drainage information with respect to actual well location and likely spill migration patterns in the event of a vehicle-related spill.

The potential level of groundwater protection measures recommended for the well serving the Early Years Kindergarten located along NH 111 may depend on whether the NH 111 section is reconstructed or relocated. Currently, NH 111 is located about 150 feet down-gradient of this facility. Under the reconstruction alternative, the roadway would be slightly closer, but still down-gradient of the well, which would suggest Level 2 measures may be sufficient. With the relocation alternative, the new roadway would be located about 150 feet from the facility but, more importantly, upgradient of the facility. This may trigger the need for added protection measures consistent with the Level 3 measures. The WHPA radius for this well is much smaller and, therefore, involves less roadway area. It appears that any opportunity to divert runoff outside of the WHPA, to the extent feasible, would be most appropriate along this roadway section.

Level 2 measures would also be considered appropriate for the roadway area within the WHPA associated with the Taylors Country Day Care facility near Windham Depot area. Level 1 protection measures, which consist of implementing appropriate stormwater treatment measures, will be used for all other wells in the project area. NHDOT also maintains a Well Replacement Program that will be utilized to address any future reported adverse impact to public and private wells. Additional details of this Program are discussed in the Mitigation section. Except at Exit 3, as mentioned above, none of the proposed park and ride facilities will be in the WHPAs of the identified public wells.

#### 4.4.3.4 Mitigation

Consistent with NHDES's Recommendations for Groundwater Protection Measures When Siting or Improving Roadways, the need and type of groundwater protection measures have been evaluated for the various public wells and other groundwater resources identified in the project area. As discussed in Section 4.4.1, the proposed project will incorporate extended-detention basins and grassed swales to treat roadway runoff for nearly the entire reconstructed roadway, including existing and new pavement areas. This is consistent with NHDES's recommended structural measures under Level 2 protection measures for all new and improved roadways in Wellhead Protection Areas (WHPAs), locally designated groundwater protection areas or areas classified as GA1 areas (i.e., watersheds or recharge areas to existing or future water supplies) under the WHPA Program. Additional Level 3 measures will be incorporated into the proposed project design to prevent impacts to specific community and non-community, non-transient public wells that will be within 500 feet of the proposed roadway. This includes approximately 2,000 feet of the new I-93 roadway near the Boumil Grove Condominiums in Londonderry just south of Exit 4-Interchange area. Depending on which design alternative is selected for the Exit 3

Interchange improvements, nearly 8,000 feet of roadway south of Exit 3 and including Exit 3 may need to have Level 3 Protection Measures to protect the Pennichuck Water Company community well along West Shore Road near Canobie Lake in accordance with the NHDES Recommendations. Recommended Level 3 measures include lined grassed swales, lined median area and shoulder areas used for snow storage and higher guardrails to help prevent truck rollovers within the 4,000 foot WHPA radius around the well. Reduced salt applications are not a potential option given the need to maintain safe travel conditions on a major highway. The use of alternative deicers could also introduce other contaminants or cause other water quality problems in Canobie Lake, particularly with organic-based deicers. The recommended "tight-shift" design alternative for Exit 3 improvements would move the I-93 roadway about 1,000 feet or more from the Pennichuck wells, which would reduce the recommended mitigation to Level 2 measures.

During the construction period, NHDOT will identify and include precautions to minimize potential blasting impacts for all public and private wells within 1000 feet of a blasting area as part of the final design. NHDOT will also coordinate with the area utilities just prior to construction to prevent and repair any inadvertent damage to underground distribution lines.

In addition to the various mitigation measures discussed above that will be implemented as part of the project design to prevent groundwater contamination, NHDOT will investigate and replace any wells that have subsequently been found to be damaged or degraded as a result of NHDOT activities through its Well Replacement Program. In accordance with RSA 228: 34, NHDOT will conduct remedial measures for any wells that are found to have been impacted by construction or maintenance activities in relation to a state highway. The Well Replacement Program is initiated on an individual complaint basis. Once a complaint is received in writing regarding the nature of the impact, NHDOT will conduct an investigation to determine the most probable source of the impact. If it is found that NHDOT' activities are the most probable source, then NHDOT will initiate one of the following sources:

1. Replace or repair the damage to the supply well; or
2. Pay damages in lieu of replacement or repair, or
3. Purchase real property in lieu of replacement or repair, or
4. Assist in coordinating and reimbursement to connect to a municipal water system.

Under the Safe Drinking Water Act, NHDES requires certain monitoring requirements for most public wells, which can assist in evaluating historical trends in specific parameters.

NHDOT will continue to investigate and find opportunities to minimize the use of road salt for deicing purposes through advances in snow and ice control technology. Some of the more recent advances include truck–mounted or hand-held infrared pavement temperature sensors, newly designed snow plows, improved access to detailed weather forecasting information, and various alternative deicers.

## 4.5 Floodplain Impacts

### 4.5.1 Impact Methodology

The evaluation of floodplain impacts associated with the alternatives selected for detailed study uses information derived from the Federal Emergency Management Agency (FEMA) mapping for the study area. Floodplains (100-year frequency flood) were interpolated from FEMA Flood Insurance Rate Maps (FIRM) for each community traversed by the highway corridor. Floodways were interpolated where available from FEMA Flood Boundary and Floodway Maps for corridor communities.

FEMA defines the floodway as the channel of a stream, plus any additional floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without an increase in flood elevation greater than one foot. It should be noted that floodways have not been determined for all areas included in the FEMA studies, and floodway impacts are only presented for those streams for which available FEMA mapping identifies floodways.

The floodplain and available floodway data were transcribed onto the corridor constraint mapping, as presented in **Figure 3.5-1**. This information was overlaid with the proposed mainline and interchange options. From this analysis, floodplain and floodway impact areas were determined. No discernible differences in impacts were found among the mainline and interchange options. Table 4.5-1 presents floodplains and floodway impacts for various options and alternatives.

In addition to presentations at public informational meetings, several coordination meetings have been held with local and state officials and concerned citizens to discuss floodplain issues specific to this project. Agencies that have been involved to date include NHDOT, FHWA, FEMA, the New Hampshire Office of Emergency Management (NHOEM), the Town of Salem, the Spickett River Flood Mitigation Committee, and the Massachusetts Department of Environmental Management/Massachusetts Emergency Management Agency (MA-DEM/MEMA).

Due to the importance of Policy Brook and the Spickett River floodway and floodplain areas in the Town of Salem, a detailed analysis was completed for this system to fully evaluate potential impacts from the preferred alternative.

**Table 4.5-1**
**Floodplains and Floodway Impacts[1,2]**

| | Salem | | | | | | Windham | | Derry/Londonderry | | | | | | | | Londonderry/Manchester | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Segment A | | Segment B Exit 1 | | Segment C Exit 2 | | Segment D Exit 3 | | Segment E Exit 4 | | | | | | | | Segment F Exit 5 | |
| | 3 or 4 Lane | | 3 or 4 Lane | | 3 or 4 Lane | | 3 or 4 Lane | | 3 Lane | | | | 4 Lane | | | | 3 or 4 Lane | |
| | | | Reconstruct or Relocate Option | | Loop or Diamond Option | | Options 1-9 | | East Option | | West Option | | East Option | | West Option | | All Options at Exit 5 | |
| | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway | Floodplain | Floodway |
| **Watercourse** | | | | | | | | | | | | | | | | | | |
| Spickett River | 0 | 2.4 | | | | | | | | | | | | | | | | |
| Policy Brook | 15.0 | | 0.5 | 0 | | | | | | | | | | | | | | |
| Porcupine Brook/ Policy Brook | | | | | 12.5 | 0 | | | | | | | | | | | | |
| Harris Brook | 6.2 | | | | | | | | | | | | | | | | | |
| Golden Brook Tributary | | | | | | | 1.5 | 0 | | | | | | | | | | |
| Beaver Brook | | | | | | | | | 2..15 | 2.0 | 2.15 | 2.0 | 2.3 | 2.4 | 2.3 | 2.6 | | |
| Wheeler Pond | | | | | | | | | 1.1 | 0 | .6 | 0 | 1.55 | .05 | .6 | 0 | | |
| Tributary to Wheeler Pond | | | | | | | | | 1.7 | .4 | .03 | .02 | 2.0 | .5 | .03 | .02 | | |
| Cohas Brook/ Long Pond Brook | | | | | | | | | | | | | | | | | 2.1 | 0.7 |
| Total Floodplain Impact (acre-feet) | 21.2 | | 0.5 | | 12.5 | | 1.5 | | 4.95 | | 2.78 | | 5.85 | | 2.93 | | 2.1 | |
| Total Floodway Impact (acre-feet)* | | 2.4 | | 0 | | 0 | | 0 | | 2.4 | | 2.02 | | 2.95 | | 2.62 | | 0.7 |

1 See **Figure 2.3-11** for segment locations.
2 Excludes bike path and park & ride impacts. See text for description.

Conclusions from this analysis indicate that the 100-year flood elevation of Policy Brook and the Spickett River will experience minor, if any, change as a result of the proposed highway improvements. As such, the proposed improvements will have a negligible impact on these watercourses' ability to convey floodwaters.

The analysis was completed using the USACOE's Hydraulic Engineering Center's River Analysis Software (HEC-RAS) computer program to create an "existing conditions" hydraulic model of the study area using actual ground survey cross sections that approximates a 100-year flood event. The study looked at a 1.3-mile section of Policy Brook between Kelly Road and its confluence with the Spickett River; and a 1.5-mile section of the Spickett River from its confluence with Policy Brook to just below its confluence with Harris Brook in Massachusetts.

Once the "existing conditions" hydraulic model was established, a "proposed conditions" hydraulic model was created by modifying the existing cross sections to reflect the roadway improvements associated with the Preferred Alternative.

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## 4.5.2 Build Alternatives

The impacts resulting from the Build Alternatives are identified and discussed by segment. In all segments, except for Segment E, the floodplain and floodway impacts remain virtually the same for the Three-Lane and Four-Lane Alternatives. The reason for this similarity is due to the various environmental and engineering constraints identified during the conceptual design process with respect to widening the highway to the outside, towards the median, to the east or to the west. These constraints are identified in detail in Section 2.3.3 and briefly identified within the following impact discussion for each segment.

### Segment A

For Segment A the Build Alternatives would have the same impact on floodplains of Harris Brook and Policy Brook and floodways associated with the most northern part of the Spickett River. The layouts for the Build Alternatives are exactly the same for Segment A, therefore the impacts are the same. The Segment A improvements would result in filling approximately 6.2 acre-feet of the Harris Brook floodplain, 15.0 acre-feet of Policy Brook floodplain and 2.4 acre-feet of Spickett River floodway. Beginning at the Massachusetts border in Salem and proceeding northerly to the Rest Area, impacts resulting from the widening of I-93 would occur along both the east and west side of the highway. All of the impacts to the Spickett River are related to the sound wall construction. The majority of impacts along the Policy Brook floodplain are also related to construction of a proposed sound wall. Although impacts to the floodplain and floodway of Policy Brook, Harris Brook and the Spickett River will occur, with some impacts related to the collector-distributor road and improved ramps into the Rest Area, the proposed improvements will have a negligible impact on these watercourses' ability to convey floodwaters. The impacts to the Harris Brook floodplain are all associated with the highway widening.

### Segment B

The options for Segment B for either of the Build Alternatives would have a similar impact on floodplains. The Segment B improvements would impact approximately 0.5 acre-feet of floodplain associated with Policy Brook. This impact is a continuation of the floodplain impacts identified in Segment A along the east side of the roadway, just north of the Rest Area. No impacts to identified floodways are anticipated in this segment.

### Segment C

The options for Segment C for either of the Build Alternatives would have a similar impact on floodplains associated with Porcupine Brook and Policy Brook. The impact from each of the alternatives would be approximately 12.5 acre-feet of floodplain, with no impacts to identified floodways. The proposed impacts in this segment would occur as a result of the highway widening along the west side of I-93, north of NH 38 (Lowell Road), and along Pelham Road, east of I-93.

The widening of the southbound barrel would require replacement of the existing I-93 bridge over NH 38. This would require construction of a temporary bridge off line to the west to maintain two lanes of traffic during the construction of the new bridge. The layout for the temporary bridge would require construction of two temporary approach lanes within the floodplain, for both the Three-Lane and the Four-Lane Alternatives. The temporary bridge and approach fills would be removed following completion of the new bridge.

### Segment D

The options for Segment D for either of the Build Alternatives would have similar impacts on the floodplain associated with Golden Brook. The impacts would involve approximately 1.5 acre-feet of floodplain with no floodway impacts as a result of widening both the NB and SB barrels, within the existing median area, in the vicinity of the weigh stations, north of Exit 3. In this location, the existing outside edge of pavement was held as a control at the weigh stations north of Exit 3, and the highway widening would occur towards the median. The resulting difference in impacts of the Three-Lane Alternative versus the Four-Lane Alternative in this location would be approximately 0.1 acres. However, with consideration of maintenance of traffic during construction, two temporary lanes would be required at all times so the resulting impacts would be very similar with either the 3-Lane or the 4-Lane Alternative.

### Segment E

Segment E is the only highway section studied where the highway options result in differing impacts to floodplains and floodways. This is because the highway options include widening to the east or to the west. Similar to other segments, with consideration of maintenance of traffic during construction, the impacts associated with the Three-Lane Alternative would be similar to those with the Four-Lane Alternative.

Floodplain and floodway impacts will occur at the existing Beaver Brook crossing south of Exit 4, Wheeler Pond, and a tributary to Wheeler Pond northeast of Exit 4. For both the Three-Lane or Four-Lane Alternative, the west widening option would have the least impact. For the Three-Lane Alternative, the west option affects approximately 2.8 acre-feet of floodplain and 2.0 acre-feet of floodway, while under the Four-Lane Alternative 2.9 acre-feet and 2.6 acre-feet are affected, respectively. In contrast, the east widening option with the Three-Lane Alternative affects approximately 5.0 acres of floodplain and 2.4 acre-feet of floodway, while the Four-Lane Alternative affects 5.9 acre-feet and 3.0 acre-feet, respectively. The biggest difference between the east and west options occurs at Wheeler Pond and its tributary.

#### Segment F

Segment F for either of the Build Alternatives would have similar impacts on the floodplains and floodways associated with the existing Cohas Brook and Long Pond Brook crossings. The highway improvements under either of the alternatives would result in approximately 2.1 acre-feet of direct impact to floodplain and 0.7 acre-feet of direct impact to floodway.

#### Bike Path

An estimated 0.4 acres of floodway and 2.6 acre-feet of 100-year floodplain would be impacted by the addition of a bike path with either the Three-Lane or Four-Lane Alternative.

#### Park and Rides

There will be no impacts on floodways or 100-year floodplains with the new park and ride lots proposed at Exits 2, 3 and 5.

#### Sound Walls

Since the proposed sound walls are being erected within the right-of-way, their impacts on floodways and 100-year floodplains have been taken into account in the above discussion for the Build Alternatives.

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### 4.5.3 No-Build Alternative

The No-Build Alternative would result in no new impacts to floodplains or floodways within the study area.

### 4.5.4 Mitigation

Direct impacts to the 100-year floodplain and floodways have been minimized in the preliminary design developed to date by steepening highway embankments and/or utilizing retaining walls where appropriate. Such location include the areas adjacent to the Spickett River, Policy Brook, and Porcupine Brook in Salem; Beaver Brook in Derry and Londonderry, Wheeler Pond in Londonderry, and Cohas Brook in Manchester.

Additional mitigation will involve creating flood storage in locations adjacent to flood susceptible brooks and rivers, or locations upgradient from flood prone areas. Detention basins are being proposed for stormwater treatment and floodwater storage at a number of locations along the widened highway (see Water Quality Sections 4.4.1 and 4.4.3 and **Figures 2.7-1 to 2.7-22**). These basins are typically designed to store up to a 50-year storm event before discharging to nearby watercourses.

In addition, the proposed wetland mitigation package will include some wetland creation sites in part functioning as flood storage compensation areas. These sites include the following: Pelham Road Mitigation Site, Waste Water Treatment Plant, and Baggett Site in Salem; Highway Median Site in Windham; South Road Mitigation Site in Londonderry; and Cohas Avenue Site in Manchester. One of the goals in the design of these mitigation sites will be the replacement of floodflow alteration and storage, one of the principal functions performed by the wetlands unavoidably impacted by the project (see Section 4.6.2.4 and **Figure 4.6-2** for additional information).

### 4.5.5 Floodplain Finding

A Floodplain Finding according to Executive Order 11988, *Floodplain Management* (May 24, 1977) will be provided as part of FEIS. FHWA policies and procedures also cover the impact of projects on floodplains and floodways, and are found in *Location and Design of Encroachments on Floodplains* (23 CFR 650A).

A detailed analysis has been completed for Policy Brook and its confluence with the Spickett River to fully evaluate potential hydraulic impacts associated with the Preferred Alternative. Conclusions indicate that the Preferred Alternative will have negligible impact on the ability of these watercourses to convey floodwaters. Additional studies may be required for evaluating floodway impacts in other locations. They would appear to be minor relative to increasing flood elevations.

# 4.6 Land Resources Impacts

## 4.6.1 Farmlands

### 4.6.1.1 Impact Methodology

Impacts on Important Farmland Soils (see Section 3.6.2 for definitions) were calculated by overlaying the alternative designs on maps identifying the particular soil series associated with prime, unique, state-wide important, and locally important farmlands (see **Figure 3.6-2**). Impacts were recorded for segments A through F. The Farmland Protection Policy Act (FFPA) of 1984 requires that all Federal agencies assess the effect of converting existing or potential farmland areas to non-agricultural use. The FFPA specifically directs federal agencies to (1) identify the effect of federally funded projects on farmland; (2) consider alternative actions to lessen impacts; and (3) ensure the project, to the extent practicable, is compatible with local, state, or federal programs to protect farmlands. FFPA specifically excludes areas identified through either state or local planning for commercial, industrial, or residential land uses. Lands already developed are also excluded from the analysis. Important farmland soils, that laid within the I-93 right-of-way, were hence excluded from analysis as having already been "converted" to highway use. Results of the analysis were used to prepare the US Department of Agriculture's Farmland Conversion Impact Rating Form. (see Appendix C).

Impacts on active farmland or areas currently in use for row crops, hayfields/pastures, and orchards were estimated by visual inspection along the actual corridor.

### 4.6.1.2 Build Alternatives

Impacts to important farmland soils as well as active farmland are summarized in Table 4.6-1 and described below.

#### Three-Lane Alternative

#### Segment A

Approximately 0.4 acres of locally important farmland soils will be impacted by the Three-Lane Alternative in Segment A. These soils lie on both sides of the highway just north of the Massachusetts/New Hampshire state line. No other important farmland soils are impacted within this segment. No active farmland is affected.

**Table 4.6-1**
**Farmland Impacts for the Build Alternatives as Compared to No-Build**

| | | | Widening Options by Segment | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Salem | | | | | Windham | Derry/ Londonderry | | Londonderry/ Manchester | | | | | |
| | | | A | B | | C | | D | E | | F | | | All Segments | | |
| | | | | Exit 1 | | Exit 2 | | Exit 3 | Exit 4 | | Exit 5 | | | | | |
| | Options | No- Build | South of Cross Street | Reconstruct | Relocate | Loop | Diamond | Options 1-9 | East | West | Relocate NH 28 | Reconstruct NH 28 | Relocate NB Ramp | Bike Path (Max. – worst case) | Park & Rides (New Facilities at Exits 2, 3 and 5) | TOTAL IMPACTS |
| **Three-Lane Alternative** | Prime Farmland Soils (Acres) | | 0 | 0 | 0 | 3.2 | 2.9 | 0.3 | 0.5 | 0.4 | | 0 | | 1.0 | | 4.6-5.0 |
| | Farmland Soils of Statewide Importance (Acres) | No Impacts | 0 | 0.3 | 0.3 | 2.7 | 1.6 | 0.4 | 0 | 0 | | 0.3 | | 0.0 | Negligible | 2.6-3.7 |
| | Farmland Soils of Local Importance (Acres) | | 0.4 | 0.3 | 0.3 | 2.1 | 2.0 | 0 | 0 | 0.5 | | 0.3 | | 3.6 | | 6.6-7.2 |
| | Total (Acres) | | 0.4 | 0.6 | 0.6 | 8.0 | 6.5 | 0.7 | 0.5 | 0.9 | | 0.6 | | 4.6 | | 13.9-15.8 |
| | Active Farmland (Acres) | | 0 | 0.4 | 0.4 | 0 | 0 | 0 | 0 | 9.0 | | 0 | | < 1 | | 1.4-10.4 |
| **Four-Lane Alternative** | Prime Farmland Soils (Acres) | | 0 | 0 | 0 | 3.2 | 3.1 | 0.3 | 0.8 | 0.4 | | 0 | | 2.7 | | 6.5-7.0 |
| | Farmland Soils of Statewide Importance (Acres) | No Impacts | 0 | 0.3 | 0.3 | 2.7 | 1.6 | 0.4 | 0 | 0 | | 0.3 | | 0.0 | Negligible | 2.6-3.7 |
| | Farmland Soils of Local Importance (Acres) | | 0.4 | 0.4 | 0.4 | 2.2 | 2.2 | 0 | 0 | 1.2 | | 0.3 | | 3.6 | | 6.9-8.1 |
| | Total (Acres) | | 0.4 | 0.7 | 0.7 | 8.1 | 6.9 | 0.7 | 0.8 | 1.6 | | 0.6 | | 6.3 | | 16.4-18.4 |
| | Active Farmland (Acres) | | 0 | 0.4 | 0.4 | 0 | 0 | 0 | 0 | 9.0 | | 0 | | < 1 | | 1.4-10.4 |

### Segment B

An estimated 0.3 acres of statewide important soils are impacted immediately adjacent to Exit 1 on the west side, while 0.3 acres of locally important soils are affected on both the west and east sides of the highway in Segment B under the Three-Lane Alternative. Some active farmland (0.4 acres) will be impacted in the southeast quadrant of Exit 1 for either the reconstruct or relocate options.

### Segment C

Prime, statewide, and locally important farmland soils will be impacted at Exit 2 in the loop and diamond options for the 3-Lane Alternative, primarily north and west of the interchange. The two options will impact 3.2 acres and 2.9 acres of prime farmland soils, respectively, with most of the impact in the northeast quadrant of the interchange. In addition, the loop option will impact 2.7 acres of statewide important soils and 2.1 acres of locally important soils, whereas the diamond option will impact 1.6 acres of statewide and 2.0 acres of locally important soils. No active farmlands will be impacted with either option.

### Segment D

Segment D contains 9 options. Farmland impact quantities were calculated for the entire segment and not for each option. There was little if any difference in impacts among the options. Options 1 through 9 in Segment D for the Three-Lane Alternative will impact 0.3 acres of prime farmland soils and 0.4 acres of statewide important farmland soils. Prime farmland soil impacts are located along Bridge Street in Windham. Impacts to statewide important soils occur off Morrison Road and North Lowell Road in Windham. No locally important farmland soils or active farmland will be impacted in Segment D. No active farmland will be affected within Segment D.

### Segment E

The impacts to important farmland soils in Segment E for the Three-Lane Alternative occur adjacent to Pillsbury Road, north of Exit 4 as well as directly along the existing mainline. Prime farmland will be impacted almost equally if the existing highway is widened to the east or the west, impacts will be 0.5 and 0.4, respectively. There will be no impacts to statewide important soils. However, there will be an impact to the locally important soils (0.5 acres) if the mainline is widened to the west. There will be no impacts to active farmland for the easterly widening of Segment E. The westerly widening would affect slightly less than 5.4 acres of the active Woodmont Orchard property for right-of-way acquisition and a little less than 3.6 acres for slope work.

### Segment F

Important farmland soils are situated in various locations along the mainline in this segment. Primary areas include land surrounding Long Pond Brook, Bodwell Road, Island Pond Road, and Cohas Avenue in Manchester. A majority of these sites are either developed or already committed to development and are therefore excluded from the analysis. However, there are small portions of statewide important and locally important soils that are not developed and will be impacted to the same extent (0.3 acres) by any of the three options within Segment F. There will be no impacts to active farmlands within this segment.

## Four-Lane Alternative

### Segment A

Since the designs for both the Three-Lane and Four-Lane Alternatives are the same for this segment, approximately 0.4 acres of locally important farmland soils will be impacted by the Four-Lane Alternative in this segment. These soils lie on both sides of the highway just north of the Massachusetts/New Hampshire state line. No other important farmland soils are impacted in Segment A. No active farmland is affected.

### Segment B

Approximately 0.3 acres of statewide and 0.4 acres of locally important farmland soils will be impacted in this segment on both the west and east sides of the highway in Segment B under the Four-Lane Alternative. Approximately 0.4 acres of active farmland is impacted under either the reconstruct or relocate options in the southeast quadrant of Exit 1 under the Four-Lane Alternative.

### Segment C

Prime, statewide, and locally important farmland soils will be impacted at Exit 2 for either the loop or diamond options under the Four-Lane Alternative, primarily north and west of the interchange. The loop option will impact 3.2 acres of prime farmland, whereas 3.1 acres of prime farmland will be impacted in the diamond option with most of the impacts in the northeast quadrant of the interchange. The loop option will impact 2.7 acres of statewide important farmland soils, whereas the diamond option will impact 1.6 acres of that same type. Impacts to locally Important farmland soils are equal for both the loop and diamond options (2.2 acres). No active farmlands will be impacted with either option at Exit 2.

### Segment D

Segment D contains 9 options. Farmland impact quantities were calculated for the entire segment and not for each option. There was little if any difference in impacts among the options. Options 1 through 9 will impact 0.3 acres of prime farmland soils and 0.4 acres of state important farmland soils. Prime farmland soil impacts are located along Bridge Street in Windham. Statewide important farmland soil impacts occur off Morrison Road and North Lowell Road in Windham. No locally important farmland soils are impacted in this segment. No active farmland will be affected within Segment D.

### Segment E

Important farmland soils are impacted in this segment adjacent to Pillsbury Road, north of Exit 4 as well as directly along the existing mainline. There will be a greater impact to prime farmland, if the existing highway is widened to the east (0.8 acres) rather than to the west (0.4 acres). An estimated 1.2 acres of locally important farmland soils will be impacted if the widening takes place to the west. There will be no impacts to statewide important farmland soils for either the east or west widening options in this segment. Widening to the west will require acquisition of approximately 5.4 acres of the active Woodmont Orchard property for new right-of-way, while another 3.6 acres will likely be affected by slope work.

### Segment F

Important Farmland soils are located in various locations along the corridor. Primary areas include land surrounding Long Pond Brook, Bodwell Road, Island Pond Road, and Cohas Avenue in Manchester. A majority of these locations are either already developed or committed to development and hence not subject to the FPPA. However, there are small portions of statewide important and locally important farmland soils in areas that are not developed and that will be impacted under all three options for this segment (approximately 0.3 acres for each). There will be no impacts to active farmlands within this segment.

## Four-Lane/Three-Lane Combination

A third alternative is the combination of four lanes beginning at the state line and extending through to Exit 3 and then switching to three lanes north of Exit 3 to the I-93/I-293 split in Manchester. Hence, for Segments A-D the same impacts as for the Four-Lane Alternative will occur, while for Segments E-F they will be the same as described for the Three-Lane Alternative.

## Bike Path

Approximately 4.6 acres of additional farmland soils will be impacted under the Three-Lane Alternative with the widening required for the bike path (Table 4.6-1). An additional 6.3 acres are affected with the Four-Lane Alternative. Both alternatives affect less than one acre of active farmland.

## Park and Rides

New park and ride lots are proposed at Exits 2, 3 and 5. Impacts on important farmland soils are very small or negligible for the locations chosen.

### Sound Walls

Since the sound walls are being erected within the highway right-of-way (either existing or proposed), the conversion of farmland soils for the walls has already been taken into account in the estimates described above.

### Farmland Conversion Form

Total farmland impacts were evaluated using the US Department of Agriculture's Farmland Conversion Impact Rating Form (AD-1006; Appendix C). For simplicity the same component options (i.e., South of Cross Street in Segment A, Relocate at Exit 1, Diamond Interchange at Exit 2, Option 8 at Exit 3, the Easterly Widening at Exit 4, and Reconstruct NH 28 at Exit 5) were assumed in evaluating the Three-Lane, Four-Lane, and Four-Lane/Three-Lane Combination Alternatives. A "worst case" Four-Lane Alternative was also evaluated to represent the full range of impacts possible. Data for Parts I, III, and VI were provided by NHDOT. The NRCS completed Parts II, IV, and V. The final scores for each alternative (Part VII) and corridor selection (Part VIII) were completed by NHDOT in cooperation with FHWA.

Alternatives receiving a total score of less than 160 points are given minimal level of consideration for protection and no additional alternatives need to be evaluated (*Supplemental Guidance for Implementation of Farmland Protection Act, FHWA, January 23, 1985*). None of the alternatives has a score which exceeds the 160 point threshold requiring further coordination with NRCS.

### 4.6.1.3 No-Build Alternative

The No-Build Alternative will not affect important farmland soils or active farmland since there would be no new construction.

### 4.6.1.4 Mitigation

No mitigation other than avoidance and minimization is available for this resource, since loss of important farmland soils and the productivity associated with them for highway construction is an irretrievable and irreversible commitment of resources. Any topsoil (i.e., loam) salvaged during construction will be re-used on roadway side slopes. Additionally, Form AD-1006 shows impacts do not exceed threshold requiring further coordination with NRCS.

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## 4.6.2 Wetland Resources

NEPA, Section 404 of the Clean Water Act, and Executive Order 11990 require consideration of impacts to wetland acreage and functions and values. Other impacts considered include habitat fragmentation, the effects of runoff (erosion, sedimentation, flooding), impoundment, and other hydrologic modifications, and temporary disturbances incurred during road construction that may adversely affect wetland functioning.

Twenty-seven wetland systems have been identified within the I-93 project corridor. Wetland resources were mapped and evaluated according to the methodologies described previously in Section 3.6.3.

The majority of wetlands throughout the project study area comprise a network of interconnected systems contained within five major watersheds and several subwatersheds. In general, wetlands located within the southern one-third of the project corridor are more disturbed, altered, and fragmented than those in the northern two-thirds. Proximity to existing roads and commercial and residential development have degraded portions of most wetlands from the Massachusetts border extending to the weigh stations in Windham. Other wetlands, north of the weigh stations to the northerly project terminus, have been adversely affected to a lesser degree by adjacent land development.

As described in Section 3.6.3, a functional assessment of wetlands within the project corridor was performed in the field using the USACOE Highway Methodology (see Table 3.6-3). In general, most wetland systems were determined to possess between six and nine functions and values. The following wetland systems were determined to have attributes supporting 12 functions and values: NH 111 (Wetland System 13), Wheeler Pond and Tributary (Wetland System 21), and the Exit 5 Wetland (Wetland System 25). With regard to principal functions, in general, the assessments show that wetlands south of the weigh stations provide between three and six principal functions, whereas, wetlands to the north of the weigh stations provide between four and eight principal functions. The proposed compensatory mitigation package would consider the wetland functions and values lost due to project-related impacts and would compensate, to the degree practicable, those lost functions and values.

Impacts to wetlands associated with both the Three-Lane and Four-Lane Alternatives, and the Four-Lane/Three-Lane Alternative are described in the following sections. Compensatory mitigation to offset these proposed project impacts is discussed in Section 4.6.2.4.

### 4.6.2.1 Impact Methodology

For purposes of comparing alternatives, the areas of wetland impacts were determined by measuring the wetland area to be permanently cut or filled (including clear zones and easements) based on wetland mapping. The total amount of permanent wetland impact for each system, as well as amount of impact by cover type within each wetland, was determined.

### 4.6.2.2 Build Alternatives

Both the Three-Lane and Four-Lane Alternatives consist of similarly designed options, with the Four-Lane Alternative construction options extending an additional lane in each direction (approximately 24 feet in total) beyond the Three-Lane Alternative options. Permanent impacts associated with the Four-Lane Alternative are therefore greater than those of the Three-Lane Alternative. However, in order to maintain traffic during construction, the Three-Lane Alternative must be constructed with a temporary widening. The acreage of wetland impacts for the Three-Lane Alternative will therefore be similar to the impact of the Four-Lane Alternative, at least temporarily.

Certain proposed options, (i.e., relocation options at Exit 1 and 5, loop option at Exit 2, the northbound/southbound tight shift options at Exit 3, and the east option at Exit 4), result in greater wetland impacts than their alternative options. See **Figure 4.6-1**, which provides a graphical representation of wetland impacts for each alternative and option.

Direct wetland impacts, i.e., the loss of wetland acreage within the highway footprint, vary from 52.4 acres to 77.7 acres depending on the construction options chosen. In general, the proposed highway reconstruction follows an existing corridor. As such, the bulk of the direct wetland impacts are along the edge of wetland systems that have already been impacted by the highway construction. In most cases, these "edge impacts" represent only a small percentage of the total wetland acreage within a system and, while representing an incremental loss of wetland area, will not eliminate the functions and values performed by the remaining wetland. Exceptions to this generality are called out in the segment-by-segment discussion contained below.

Indirect impacts can also result from highway construction. For example, the loss of forest overstory adjacent to a wetland, stream, or vernal pool can eliminate shading, increase water temperature and adversely affect the ecological community. Exposure of wetland systems to noise from highway traffic can adversely affect the quality of wildlife habitat that wetlands provide. And increased sedimentation and nutrient pollution can impair water quality within wetlands and streams if stormwater controls are inadequate or not maintained.

Hydrological changes to wetlands can sometimes occur as a result of highway construction. The extension of culverts or placement of new culverts not only impacts stream bed habitat, but can affect hydrology within wetland systems, either flooding or draining a wetland area depending on how the culvert is installed. These hydrological modifications can lead to changes in the cycling of nutrients and biomass within the wetland system and can allow for a shift in the plant community associated with the area. In some cases, these changes might actually lend additional support to functions already performed by the wetlands. But, in other cases, such hydrological changes will degrade or destroy the wetland.

The results of the wetland functional analysis shows that nearly every wetland system impacted by this project serves to reduce flooding, to retain sediments and toxicants and therefore benefit water quality, and to provide wildlife habitat. Thus, direct wetland impacts will affect these most common functions to some degree. Again, since most of the wetland impacts resulting from the highway upgrade will be to the edge of systems previously impacted by the highway's original construction, and since in most cases the direct impact is a relatively small percentage of the total wetland acreage within the system, it is expected that the incremental impacts will not result in elimination of functions and values of the remaining wetland areas.

Direct impacts to wetlands associated with both the Three-Lane and Four-Lane Alternatives are described in more detail in the following sections, by highway segments, A through F. **Figure 4.6-1** presents specific impacts to wetland cover types that would result from each option within the Three-Lane and Four-Lane Alternatives.

### Three-Lane Alternative

Depending on which options are selected, impacts to wetland systems due to the Three-Lane Alternative vary from 52.4 acres to 67.1 acres. Impacts associated with the various construction options are summarized in **Figure 4.6-1** and Tables 4.6-2.

### Four-Lane Alternative

Depending on which options are selected, impacts to wetland systems due to the Four-Lane Alternative vary from 61.5 acres to 77.7 acres. Impacts to wetlands for the Four-Lane Alternative in all Segments are substantially similar to those reported for the Three-Lane Alternative. Because of the slightly larger widening, permanent impacts are somewhat higher as shown in **Figure 4.6-1** and Table 4.6-3.

### Four-Lane/Three-Lane Combination

A third alternative is the combination of a 4-lane section beginning at the state line and extending to Exit 3 and then switching to a 3-lane section after Exit 3 northerly to the I-93/I-293 split in Manchester. As the Four-Lane/Three-Lane Combination Alternative does not propose any new options, the impacts are the same relative to the specific segments as described in the previous sections. The total range of wetland impacts associated with the Four-Lane/Three-Lane Combination alternative varies from 54.5 acres to 69.5 acres depending on which option is constructed.

### Build Impacts by Segment

The following discussion summarizes the impacts to each wetland system by segment, compares impacts among options and highlights potential adverse effects to wetland functions.

## Segment A

In Segment A, only one option is proposed. Impacts to Wetland Systems 1 and 2 would total 3.7 acres for the Three-Lane Alternative and 3.9 acres for the Four-Lane Alternative (see Tables 4.6-2 and 4.6-3).

Most notably in Segment A, the highway upgrade will directly impact forested wetlands along the banks of Policy Brook (Wetland System 1). The construction may also have indirect impacts to the Brook by removing forest cover along its western bank. This impact is associated with the widening of the highway and with the construction of a sound wall designed to mitigate the highway's noise impact on Salem's Haigh Avenue neighborhood. Policy Brook and its associated wetlands should continue to perform all of their present functions under the Build Alternatives, but the wetland's ability to serve as finfish and shellfish habitat may be adversely affected by the loss of adjacent forest cover (*i.e.,* loss of shading).

Highway construction in Segment A will also cause impact to Wetland System 2, a large red maple swamp to the west of the highway. This forested system contains an intermittent tributary to the Harris Brook, which will be moved as a result of the construction. The direct impact to Wetland System 2 is expected to incrementally reduce the amount of floodflow alteration provided by this wetland.

## Segment B

Two construction options are being proposed in Segment B: Reconstruction of the Exit 1 southbound on- and off-ramps and Relocation of the ramps at Exit 1. Impacts to Wetland Systems 1 and 2 in Segment B are nearly identical between the two options. However, impacts to Wetland System 3 (Porcupine Brook Tributary and an associated red maple swamp) are substantially different, with the Reconstruct Option having 3.7 acres of impact while the Relocate Option will have approximately 7.9 acres of impact (8.2 acres for the Four-Lane Alternative).

Regardless of which option is chosen, the impacts to Wetland Systems 1 and 2 in Segment B are associated with incremental edge impacts that are not expected to substantially alter these wetland's ability to provide their current functions and values.

The Porcupine Brook Tributary Swamp (Wetland System 3) is an important complex of forested, scrub-shrub, and shallow open water. Portions of the wetland system to the west of the current Exit 1 location are relatively expansive and undisturbed and provide excellent wildlife habitat, among several other functions and values. It is this western portion of Wetland System 3 that is most substantially impacted by the construction in Segment B. Salem Prime Wetland #16 is located approximately 150 feet from construction work (filling, grading, paving, etc.) associated with relocation of the southbound ramps. In particular, the reconstruction or relocation of the Exit 1 southbound ramps will require substantial impacts to portions of the swamp which may adversely affect wildlife habitat.

### Segment C

In Segment C, two construction options at Exit 2 (loop and diamond) are being considered. While both options impact Wetland Systems 3 through 8, the loop option results in greater wetland impacts than the diamond option as shown in Tables 4.6-2 and 4.6-3.

Among the more important wetland systems in the project area, Porcupine Brook and its associated wetlands (Wetland System 4) wind their way southeasterly through the project area between Exits 1 and 2. In fact, the Brook and its wetlands parallel the existing highway within the median for 1,700 feet just north of the Lowell Road (NH 38) overpass. Porcupine Brook supports a substantial red maple floodplain forest. A portion of Wetland System 4 located east and west of the highway is designated as Salem Prime Wetland #17. Impacts to this system and its floodplain within the median are kept to a minimum, and there are no direct impacts to the Prime Wetland portions of the system, but a narrow forested portion to the west will be lost almost in its entirety (non-prime wetland). Because impacts directly adjacent to Porcupine Brook are avoided, this system should continue to provide its current wetlands functions (*e.g.*, floodflow alteration, finfish habitat, etc.), albeit at reduced levels. Note that the loop option (3.1 acres.) has slightly greater impacts to Wetland System 4 than the diamond option (2.4 acres.).

Wetland System 5 includes portions of forested, scrub-shrub, and emergent wetlands located inside the existing Exit 2 southbound ramps. This system is degraded to some degree by its landscape position adjacent to the highway and industrial/commercial land uses, but still provides water quality functions and some wildlife habitat. Both the Loop and Diamond options at Exit 2 will impact the forested and scrub-shrub wetland communities in the southwest portion of the interchange. The Diamond option, however, avoids impacts to the emergent marsh in the northwest portion of the interchange and therefore has lower overall impacts to this wetland (3.1 acres vs. 4.7 acres).

Both the Loop and Diamond Options will have similar impacts in Wetland System 6 and will cause a small incremental loss of this system's ability to provide wildlife habitat. Most notably, reconstruction of the northbound on-ramp at Exit 2 will eliminate a portion of a depressional forested wetland within this system.

Wetland System 7, a small area associated with an intermittent stream, will be nearly entirely filled by the highway upgrade. Both the Loop and Diamond Options have this effect, which will eliminate all of the wetland's existing functions and values.

Expansion of the highway and construction of a sound wall in the vicinity of Salem's South Shore Road neighborhood will impact small portions of the periphery of

Wetland System 8. These edge impacts represent only a small incremental reduction in the ability of this system to provide wetland functions.

**Segment D**

In Segment D, nine different construction options are being considered. Each of the options (1 through 9), would impact portions of Wetland Systems 9 through 17. In general, the Tight Shift Options (Options 7, 8 and 9) tend to have more impact than the Northbound Shift Options (Options 1 - 6). See Tables 4.6-2 and 4.6-3 for a summary.

Impacts to Wetland System 9, a relatively small forested wetland dominated by red maple and swamp white oak, are identical among the options. Approximately 0.4 to 0.7 acres of this 2.0 acre system will be impacted by the Build Alternatives, causing a proportional loss of wetland functions.

The Tight-Shift Options will create greater impacts to Wetland Systems 10 and 11 (3.6 acres total for the Three-Lane Alternative or 4.5 acres for the Four-Lane Alternative), than the Northbound Shift Options (1.4 acres or 1.9 acres for the two alternatives respectively). A mixture of forested, emergent, and scrub-shrub cover types, these two systems provide water quality functions up gradient of Canobie Lake. In particular, the Tight-Shift Options will result in the loss of a substantial portion of a 2.4 acre emergent and scrub-shrub wetland in Wetland System 10 and a large area of a similar environment in Wetland System 11. These marshes are located between the northbound and southbound barrels approximately 1,200 feet northwest of Canobie Lake. Loss of the emergent/scrub-shrub fraction of this system will adversely impact the system's ability to provide sediment/toxicant removal and nutrient uptake.

The area south of NH 111 near Exit 3 has a diverse mixture of forested, scrub-shrub and emergent wetlands that provide ten of the standard wetland functions. The system contains two perennial tributaries to Cobbetts Pond that provide fish habitat and recharge to the pond. All Build Alternatives will eliminate an emergent portion of the system located between the two highway barrels, which will reduce the system's ability to provide water quality functions.

Wetland System 13, a system of relatively narrow side hill forested wetlands will be impacted by construction along NH 111 in Windham. NH 111 crosses these wetlands more or less perpendicularly. They provide several principal functions including wildlife habitat and recharge to Cobbetts Pond. The full relocation of NH 111 will have roughly twice as much impact to these systems as its reconstruction in its current alignment.

Impacts to Wetland Systems 14, 15, 16 and 17 in the vicinity of the Windham Weigh Station are identical among all nine options, and are limited to edge impacts that will have minor incremental effects. (With the exception of the impacts to Vernal Pool 13 in Wetland System 14 and Vernal Pool 15a in Wetland System 15. Note that Vernal Pool 15a in impacted only if the bike path is constructed. See discussion below and in the discussion on vernal pools in Section 4.6.3.)

**Segment E**

In Segment E, two construction options are being considered, the East and West Options. Both options would impact portions of Wetland Systems 18 through 23. In total, wetland impacts due to the East Option would amount to 14.1 acres for the Three-Lane Alternative or 18.4 acres for the Four-Lane Alternative, while impacts due to the West Option would total 10.4 acres or 13.7 acres for the Three- and Four-Lane Alternatives respectively. See Tables 4.6-2 and 4.6-3 for a summary.

Wetland System 19 is a large and diverse mixture of emergent, forested and open water components that contains Derry Prime Wetland #6F and #7F. Direct impacts to the prime wetland are avoided, although some clearing and grading will occur adjacent to the prime wetland. Additionally, a portion of the non-prime portion of Wetland System 19 will be filled within the highway median and to the west of the highway. Because this wetland occurs on both sides of the highway, complete avoidance is not possible under the Build Alternatives, although the East Option result in slightly lower impacts overall compared to the West Option.

Beaver Brook and associated wetlands (Wetland System 20) will be impacted by the highway widening. Beaver Brook is an important freshwater stream that flows from Beaver Lake in Derry, and extends south to the state line in Pelham, then joins the Merrimack River in Dracut, Massachusetts. Although impacts to the Brook itself do not vary appreciably between the two options, the West Option has lower impacts on the system as a whole (2.0 acres or 3.5 acres for the Three- and Four-Lane Alternative, respectively) as compared to the East Option (3.4 acres or 4.2 acres). Extension of the culvert in this vicinity will degrade to some degree the system's ability to provide for finfish and shellfish habitat, although this adverse effect should be limited to the footprint of the widened highway. Other functions performed by the system will be incrementally reduced, but should remain present in all cases.

Impacts to Wetland Systems 21, 22, and 23 north of Exit 4 are largely restricted to relatively minor edge impacts. Notably, direct impacts to Wheeler Pond (Wetland System 21) have been avoided. However, there are small impacts to the emergent marsh in the southwest corner of the pond (previously disturbed) and to forested wetland just to the northwest of the pond. Portions of Wetland System 22 within the existing median just north of the Pillsbury Road overpass will be lost, and the Eastern Option encroaches on two vernal pool areas within this system (Vernal Pool 20 and Vernal Pool 21, see Section 4.6.3 for a discussion of vernal pools.) However, since the majority of the impacts in Systems 21, 22, and 23 are relatively small in relation to their total size, and since these systems are already fragmented by the highway, these wetland impacts are expected to result in only small incremental losses in wetland functions and values.

## Segment F

In Segment F, three construction options are proposed, all of which would result in impacts to Wetland Systems 23 through 27. In total, the Relocate Northbound Ramps option would result in greater wetland impacts (14.6 acres for the Three-Lane Alternative or 18.6 acres for the Four-Lane Alternative) than the Relocate NH 28 and Reconstruct NH 28 options (13.5 acres or 17.4 acres).

Wetland System 24 (Londonderry Central) is a relatively intact, moderately-sized forested and emergent wetland with a diverse plant community. It provides several wetland functions, including substantial wildlife habitat and sediment/toxicant retention. Of the three construction options, the relocation of the northbound Exit 5 ramps would cause the most extensive impacts to this area (3.7 acres or 4.1 acres for the Three- and Four-Lane Alternatives), which would likely eliminate or substantially impair this wetland's functions and values. Other options (Relocate and Reconstruct NH 28) have less substantial impacts (1.2 acres or 1.5 acres), and are limited to edge effects along the system's periphery.

Impacts to Wetland System 25 would be greater with the Relocate and Reconstruct NH 28 options compared to Relocate Northbound Ramps option. This wetland is among the larger and more noteworthy systems in the study corridor, providing twelve of thirteen of the standard wetland functions and values. The system is upgradient of the Little Cohas Brook system (which is located west of the highway corridor) and provides substantial wildlife habitat, finfish habitat, aesthetic value and water quality benefits including floodflow alteration. All three options would have similar impacts to portions of Wetland System 25 in the existing median and to the west of the highway. However, the Relocation and Reconstruction Options would fill portions of the scrub-shrub, emergent marsh and open water pond to the east and north of the Exit 5 interchange. These additional impacts will incrementally reduce the ability of the system to provide floodflow alteration, wildlife habitat, and finfish habitat.

North of Exit 5, the Build Alternatives all propose identical impacts to Wetland Systems 26 and 27. These tend to be relatively small edge effects. Cohas Brook (Wetland System 26), a regionally important stream and wetland complex parallels the highway corridor for nearly two miles in this northern-most portion of the project area, including flowing within the median for approximately 4,900 feet. Like Porcupine Brook to the south, this system supports a substantial red maple

**Table 4.6-2**
**Summary of Wetland Impacts, All Segments**
**Three-Lane Alternatives**

| | | | Segment A | Segment B Exit 1 | | Segment C Exit 2 | | Segment D Exit 3 | | | | | | | | | Segment E Exit 4 | | Segment F Exit 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wetland Number | Wetland Name | Total Wetland Area | So. Cross St. | Recon. | Reloc. | Loop | Diam | Opt 1 | Opt 2 | Opt 3 | Opt 4 | Opt 5 | Opt 6 | Opt 7 | Opt 8 | Opt 9 | East | West | Reloc NH 28 | Recon NH 28 | Reloc NB Ramp |
| 1 | Policy Brook/Spickett River | 3.7 ac. | 0.8 ac | 0.1 ac. | 0.3 ac | | | | | | | | | | | | | | | | |
| 2 | Harris Brook Tributary | 22.3 | 2.9 | 0.1 | 0.1 | | | | | | | | | | | | | | | | |
| 3 | Porcupine Brook Tributary | 40.2 | | 3.7 | 7.9 | 1.0 ac. | 1.0 ac. | | | | | | | | | | | | | | |
| 4 | Porcupine Brook | 21.5 | | | | 2.6 | 2.4 | | | | | | | | | | | | | | |
| 5 | Exit 2 | 13.1 | | | | 4.7 | 3.1 | | | | | | | | | | | | | | |
| 6 | Policy Brook | 13.1 | | | | 2.7 | 2.7 | | | | | | | | | | | | | | |
| 7 | Porcupine Brook Tributary | 1.0 | | | | 0.6 | 0.6 | | | | | | | | | | | | | | |
| 8 | Canobie L South Tributary | 2.3 | | | | 0.6 | 0.4 | | | | | | | | | | | | | | |
| 9 | No. Tributary to Policy Brook | 2.0 | | | | | | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | 0.4 ac. | | | | | |
| 10 | Canobie Lake West Trib. | 8.3 | | | | | | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 1.7 | 1.7 | 1.7 | | | | | |
| 11 | Route 111A | 28.6 | | | | | | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 1.9 | 1.9 | 1.9 | | | | | |
| 12 | Exit 3 | 19.8 | | | | | | 4.9 | 4.9 | 6.0 | 6.0 | 3.7 | 3.7 | 4.8 | 4.8 | 4.8 | | | | | |
| 13 | Route 111 | 17.1 | | | | | | 1.0 | 1.0 | 2.2 | 2.2 | 2.2 | 2.2 | 1.0 | 2.1 | 2.1 | | | | | |
| 14 | Weigh Stations South | 5.4 | | | | | | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | | | | | |
| 15 | Weigh Stations North | 11.6 | | | | | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | | | | | |
| 16 | Bridge Street Pond | 7.1 | | | | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | | | |
| 17 | Windham North | 14.9 | | | | | | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | | | | | |
| 18 | Derry South | 11.8 | | | | | | | | | | | | | | | 1.4 ac. | 1.4 ac. | | | |
| 19 | Derry Central/North | 16.9 | | | | | | | | | | | | | | | 2.8 | 3.0 | | | |
| 20 | Beaver Brook | 23.5 | | | | | | | | | | | | | | | 3.4 | 2.0 | | | |
| 21 | Wheeler Pond and Trib | 15.4 | | | | | | | | | | | | | | | 2.0 | 1.0 | | | |
| 22 | Pillsbury Rd to PSNH | 28.5 | | | | | | | | | | | | | | | 4.3 | 2.7 | | | |
| 23 | Stonehenge Road | 13.5 | | | | | | | | | | | | | | | 0.2 | 0.3 | 0.5 ac. | 0.5 ac. | 0.5 ac. |
| 24 | Londonderry Central | 10.9 | | | | | | | | | | | | | | | | | 1.2 | 1.2 | 3.7 |
| 25 | Exit 5 | 46.7 | | | | | | | | | | | | | | | | | 5.3 | 5.3 | 3.9 |
| 26 | Cohas Brook | 31.7 | | | | | | | | | | | | | | | | | 5.1 | 5.1 | 5.1 |
| 27 | I-93/I-293 Interchange | 45.0 | | | | | | | | | | | | | | | | | 1.4 | 1.4 | 1.4 |
| | **Total Impacts (acres)** | | **3.7** | **3.9** | **8.3** | **12.2** | **10.2** | **11.0** | **11.0** | **13.3** | **13.3** | **11.0** | **11.0** | **13.1** | **14.2** | **14.2** | **14.1** | **10.4** | **13.5** | **13.5** | **14.6** |

Notes: "Wetland Area" is the total area of the wetland within the study corridor within 1,000 feet of the highway centerline. In some cases, wetland systems may extend outside of this zone and therefore wetland area will be an underestimate.

**Table 4.6-3**
**Summary of Wetland Impacts, All Segments**
**Four-Lane Alternatives**

| | | | Segment A | Segment B Exit 1 | | Segment C Exit 2 | | Segment D Exit 3 | | | | | | | | | Segment E Exit 4 | | Segment F Exit 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wetland Number** | **Wetland Name** | **Total Wetland Area** | **So. Cross St.** | **Recon.** | **Reloc.** | **Loop** | **Diam** | **Opt 1** | **Opt 2** | **Opt 3** | **Opt 4** | **Opt 5** | **Opt 6** | **Opt 7** | **Opt 8** | **Opt 9** | **East** | **West** | **Reloc NH 28** | **Recon NH 28** | **Reloc NB Ramp** |
| 1 | Policy Brook/Spickett River | 3.7 ac | 0.7 ac | 0.1 ac | 0.1 ac | | | | | | | | | | | | | | | | |
| 2 | Harris Brook Tributary | 22.3 | 3.2 | 0.1 | 0.1 | | | | | | | | | | | | | | | | |
| 3 | Porcupine Brook Tributary | 40.2 | | 3.7 | 8.2 | 1.0 ac | 1.0 ac | | | | | | | | | | | | | | |
| 4 | Porcupine Brook | 21.5 | | | | 2.9 | 2.7 | | | | | | | | | | | | | | |
| 5 | Exit 2 | 13.1 | | | | 4.7 | 3.1 | | | | | | | | | | | | | | |
| 6 | Policy Brook | 13.1 | | | | 2.7 | 2.5 | | | | | | | | | | | | | | |
| 7 | Porcupine Brook Tributary | 1.0 | | | | 0.6 | 0.6 | | | | | | | | | | | | | | |
| 8 | Canobie L South Tributary | 2.3 | | | | 0.7 | 0.7 | | | | | | | | | | | | | | |
| 9 | North Trib to Policy Br | 2.0 | | | | | | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | 0.7 ac | | | | | |
| 10 | Canobie L West Trib | 8.3 | | | | | | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 2.4 | 2.4 | 2.4 | | | | | |
| 11 | Route 111A | 28.6 | | | | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.1 | 2.1 | 2.1 | | | | | |
| 12 | Exit 3 | 19.8 | | | | | | 4.9 | 4.8 | 6.0 | 6.0 | 3.7 | 3.7 | 4.8 | 4.8 | 4.8 | | | | | |
| 13 | Route 111 | 17.1 | | | | | | 1.0 | 1.0 | 2.2 | 2.2 | 2.2 | 2.2 | 1.0 | 2.1 | 2.1 | | | | | |
| 14 | Weigh Stations South | 5.4 | | | | | | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | | | | | |
| 15 | Weigh Stations North | 11.6 | | | | | | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | | | | | |
| 16 | Bridge Street Pond | 7.1 | | | | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | | | |
| 17 | Windham North | 14.9 | | | | | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | | |
| 18 | Derry South | 11.8 | | | | | | | | | | | | | | | 1.5 ac | 1.5 ac | | | |
| 19 | Derry Central/North | 16.9 | | | | | | | | | | | | | | | 3.0 | 3.3 | | | |
| 20 | Beaver Brook | 23.5 | | | | | | | | | | | | | | | 4.2 | 3.5 | | | |
| 21 | Wheeler Pond and Trib | 15.4 | | | | | | | | | | | | | | | 2.3 | 0.5 | | | |
| 22 | Pillsbury Rd to PSNH | 28.5 | | | | | | | | | | | | | | | 7.0 | 4.4 | | | |
| 23 | Stonehenge Road | 13.5 | | | | | | | | | | | | | | | 0.4 | 0.5 | 1.0 ac | 1.0 ac | 1.0 ac |
| 24 | Londonderry Central | 10.9 | | | | | | | | | | | | | | | | | 1.5 | 1.5 | 4.1 |
| 25 | Exit 5 | 46.7 | | | | | | | | | | | | | | | | | 8.4 | 8.4 | 7.0 |
| 26 | Cohas Brook | 31.7 | | | | | | | | | | | | | | | | | 5.1 | 5.1 | 5.1 |
| 27 | I-93/I-293 Interchange | 45.0 | | | | | | | | | | | | | | | | | 1.4 | 1.4 | 1.4 |
| | **Total Impacts (acres)** | | **3.9** | **3.9** | **8.4** | **12.6** | **10.6** | **12.4** | **12.3** | **14.7** | **14.7** | **12.4** | **12.4** | **14.9** | **16.0** | **16.0** | **18.4** | **13.7** | **17.4** | **17.4** | **18.6** |

Notes: "Wetland Area" is the total area of the wetland within the study corridor within 1,000 feet of the highway centerline. In some cases, wetland systems may extend outside of this zone and therefore wetland area will be an underestimate.

floodplain forest along its length. All three design options in this Segment avoid substantial impacts to this system. The largest portion of the impact to this system is associated with its southern-most forested portion that, while draining towards the Brook, is not directly adjacent to the floodplain forest. Note that the Cohas Brook itself will be impacted in two locations where the Brook crosses the northbound barrel. It is expected that the highway construction will have only a small incremental adverse impact on this system's ability to provide wetland functions and values in Wetland Systems 26 and 27.

## Bike Path

Construction of the bike path would result in some additional wetland impacts along the project corridor. As currently designed, the bike path would result in 9.3 acres of additional wetland impacts. No additional wetland impacts would occur within Segment A or B due to Bike Path Construction. Additional wetland impacts in Segment C would amount to 1.6 acres (PFO, PEM, and PSS) with construction of the diamond option. In Segment D, construction of Option 8 would result in 3.2 acres of additional wetland impacts (PFO, PEM, PSS, and POW). Additionally, Vernal Pool 15a would be impacted by construction of the bike path near the northbound Windham weigh station in Segment D. In Segment E an additional 4.1 acres of PFO, PEM, PSS and POW would be impacted with construction of the east option. In Segment F, an additional 0.4 acres of PFO and PSS would be impacted by reconstruction of NH 28 option.

## Sound Walls

Impacts to wetlands due to construction of sound walls within the project corridor are included in the impact figure for each of the Three-Lane, Four-Lane, and Four-Lane/Three-Lane Combination Alternatives.

## Park and Ride Facilities

New park and ride lots are proposed for Exit 2, 3 and 5 which would result in additional wetland impacts. Depending on which park and ride option is constructed, wetland impacts would vary from 0.9 to 2.6 acres. Proposed park and ride concepts are shown on **Figures 2.3-38, 2.3-39 and 2.3-41**.

At Exit 2, wetland impacts due to the new park and ride lot would amount to 0.5 acre of emergent wetland. At Exit 3, less than 0.1 acre of impact to forested and emergent wetlands would occur due to the tight shift option park and ride. If the Northbound Shift Option is constructed, impacts resulting from construction of a park and ride lot would be approximately 0.3 acres.

At Exit 5, wetland impacts due to Option 1 would amount to 0.5 acre of forested wetland and Option 2 would result in 0.6 acre. Option 3 would result in 0.7 acre of impact whereas Option 4 would have an impact of 0.3 acre. Construction of Option 5 would result in the most impact of any of the options at Exit 5, with 1.8 acres of forested and emergent wetland impact.

### Prime Wetland Impacts

As discussed in Section 3.6.1, designated Prime Wetlands are located in the Towns of Salem and Derry. Prime Wetlands are areas designated by municipalities and NHDES that are given a higher level of regulatory protection than non-designated areas.

Because of their importance, direct impacts to prime wetland have been avoided through careful project design. As such, the hydrology of these wetlands areas will be maintained. In addition, no direct stormwater discharges will occur in prime wetlands. Work occurring adjacent to prime wetlands includes clearing and grading to allow widening of the highway in both towns and associated with the bike path in Derry.

## 4.6.2.3 No – Build Alternative

The No-Build Alternative would not have any direct construction-related impacts on wetland resources since there would be no new construction.

## 4.6.2.4 Compensatory Wetland Mitigation

In 1989, the USACOE and USEPA signed a memorandum of agreement (MOA) that established a policy consistent with a goal of no net loss of wetlands. The federal policy requires that wetland impacts be avoided, or if avoidance is not practical, then steps must be taken to minimize the impact of a project. Where impacts occur, compensatory mitigation may be used to offset the wetland impacts. The 1989 MOA provides guidelines for USACOE and USEPA personnel when considering compensatory mitigation requirements for wetland permit applications. **Figure 4.6-2** shows the location of potential wetland mitigation sites that are being considered for this project.

In the early 1990s, based on very limited information, the wetland impacts associated with widening I-93 were estimated to be approximately 30 to 35 acres. In an effort to facilitate the permitting process and to satisfy the compensatory mitigation requirement of the MOA, the search for potential advanced wetland mitigation sites was initiated in 1995.

As agreed to by both state and federal resource agencies during discussions at several monthly Natural Resource Agency Coordination Meetings, wetland impacts incurred during previously constructed projects within this segment of the I-93 corridor are to be mitigated as part of the wetland mitigation package associated with the I-93 widening from Salem to Manchester. These projects include bridge rehabilitations and/or replacements over: Stonehenge Road and Fordway Extension in Londonderry; over NH Route 111A in Windham; over Kendall Pond Road, and North Lowell Road (Bridge Street) in Derry; over Bodwell Road, Cohas Brook and I-293 on-ramp in Manchester. Other projects include the construction of the Rest Area in Salem, and the Weigh Stations in Windham. Wetland impacts collectively amount to 4.5 acres from these projects.

In March 1999, a Public Hearing was held to consider the merits of going forward with the development of two advanced wetland creation sites: the South Road Mitigation Site in Londonderry (formerly known as L-8, L-8 Extension, and L-12) and Pelham Road Mitigation Site in Salem (S-3). At the time of the meeting, there was a consensus among the agencies that these mitigation sites would largely address the mitigation requirements relative to direct impacts to wetlands. The South Road and Pelham Road sites were accepted by the agencies and the advanced mitigation project received design approval from FHWA on June 2, 1999. Construction of the Pelham Road Site is complete. Design of the South Road Mitigation Site is currently underway and construction is expected to commence in 2003/2004.

In August 2000, the first of several Environmental Streamlining meetings was held to initiate a process whereby agency "partnering" in advance of the EIS preparation could collectively make the complex environmental process more efficient for this important project. The I-93 widening project was the first to formally adopt agency partnering protocols that would benefit the I-93 project and potentially serve as a model for other projects.

As part of the "streamlining" process, federal and state agencies have met a number of times in various forums to identify wetland mitigation "package" components with the goal of obtaining early acceptance of an assemblage of mitigation components that would adequately compensate for wetland impacts. The mitigation package components are described at the end of this section. Also included in the following sections is a summary of the mitigation site selection process (creation and preservation), and a descriptive summary of current and proposed wetland mitigation sites. Coordination letters between the USEPA and NHDOT relative to the mitigation plan are included in Appendix J.

### Advanced Wetland Mitigation Site Selection

Each of the five communities along the I-93 corridor was contacted in an effort to locate potential sites advanced for advanced compensatory mitigation. Meetings and discussions were conducted with the conservation commissions, and town or city officials to learn of potential sites that might satisfy mitigation requirements in advance of the actual I-93 widening construction. Preferably, potential advance mitigation sites would meet the following criteria:

- Have evidence of appropriate hydrology by either being adjacent to functioning wetlands, adjacent to streams or rivers, or influenced by a high water table.
- Currently disturbed or degraded, whether wetland or upland.
- Large enough to provide a minimum of 3.0 acres of mitigation area.
- Accessible and reasonably close to I-93.
- Involve wetland creation and/or enhancement, as opposed to preservation only.
- Involve publicly, versus privately, owned property.

Each potential site was subsequently field investigated by wetland mitigation specialists to discern the likelihood and cost-effectiveness of creating productive wetlands and wetlands of sufficient size. Additional factors considered during the mitigation selection process included:

- Proximity of the site to other wetlands.
- Current status of degradation of the site.
- Amount of site alteration required to create or restore wetlands.
- Quality and usefulness of the material excavated from the site.

### Advanced Wetland Mitigation Sites

Based upon the aforementioned sets of criteria, two sites were proposed and approved. The Londonderry site is currently being designed and the Salem site has been constructed. Characteristics and attributes of these sites, known as the South Road Mitigation Site, and Pelham Road Mitigation Site, are described below. See **Figure 4.6-2** for wetland mitigation site location.

**South Road Mitigation Site** (shown as Site #14 and 15 in **Figure 4.6-2**) is a 75-acre collection of three lots located west of the Londonderry/Derry border near the intersection of South Road and Gilcreast Road in Londonderry. The site borders Beaver Brook, which is a designated Conservation District pursuant to local ordinances in Londonderry. Large portions of two of the lots were privately-owned gravel pits until purchased by NHDOT, with the potential to become residential development. The third lot is mainly wetlands associated with Beaver Brook. Principal wetland functions and values expected to be provided by the site include groundwater recharge/discharge, fish and shellfish habitat, sediment/toxicant retention, and wildlife habitat. Situated on Map 7 of the Londonderry lot and parcel maps, the three lots are identified as: Lot 111 (24.4 acres), Lot 113 (38.0 acres), and Lot 114 (12.8 acres). An estimated 11 acres of creation and/or enhancement and approximately 64 acres of preservation will be provided by the site. Created wetland areas are currently being designed for the site. Construction of the mitigation area(s) is scheduled to begin in Fall 2003.

The main characteristics favoring use of this site are:

- Large site which could accommodate extensive mitigation needs.
- Good site access; the site is located approximately 0.8 miles west of I-93.

- High likelihood for success; Beaver Brook passes through the site.
- Portions of the site may provide important turtle nesting habitat.
- For the most part, the excavation depths should be relatively shallow.
- Groundwater monitoring data has been collected on a continual basis from a number of wells on the site.
- The site is contiguous with other wetlands and publicly-owned property.

**Pelham Road Mitigation Site** (Site #31) is located in Salem, west of Exit 2, south of Pelham Road, and consists of three former lots of varying dimensions totaling 24.6 acres in size. Porcupine Brook, a designated Salem Prime Wetland, passes through the site. A portion of the northern-most lot was subdivided and is occupied by a commercial skating rink. The portion of the lot used for mitigation was degraded, having served as an area for excavation and for disposal of fill materials and refuse. These portions were developed into wetlands and combined into the Porcupine Brook wetland system (for additional flood storage) with minimal site grading and excavation. Principal wetland functions and values provided by the site include floodflow alteration, sediment/toxicant retention, nutrient removal, sediment/shoreline stabilization, and wildlife habitat. The site provides about 4 acres of creation/enhancement and about 21 acres of preservation. Construction was completed in 2001.

The main characteristics favoring use of this site were:

- The size is acceptable and could accommodate a reasonable amount of mitigation in a fairly developed area.

- The mitigation enhanced the designated Prime Wetlands associated with the Porcupine Brook Watershed.

- Good access exists to the site; the site is located within 0.5 miles of I-93.

- The site is directly located in a watershed that will be impacted by reconstruction of I-93.

- Excellent likelihood for success of the mitigation effort due to the presence of Porcupine Brook passing through the site.

- Provided additional flood storage for the town with minimal additional cost.

### Additional Site Selection

With the development of widening layouts (albeit conceptual) and better estimates of potential impacts associated with widening I-93, and with the understanding that some additional mitigation would need to be considered to offset impacts to all five communities along the corridor, further investigations and discussions were begun to consider what other mitigation would be appropriate. Discussions and meetings were conducted with the conservation commissions, natural resource agencies, town or city officials, other interested individuals, and the general public to obtain recommendations and information about specific properties. Discussion with the resource agencies indicated a shift in priorities away from wetland creation and enhancement, and instead emphasized preservation of large undeveloped tracts of land.

In general, the mitigation sites which are to be considered in addition to the advanced site meet some of the following criteria:

- Are areas threatened by imminent development within communities impacted by the highway project.
- Have a mix of relatively undisturbed uplands and wetlands that provide important wildlife habitat or contain rare/threatened plant or animal communities.
- Lie adjacent to functioning wetlands, streams or rivers, or undeveloped areas, thereby providing or enhancing continuity with established wildlife corridors or greenways.
- Contain wetlands that provide similar functions and values as those impacted by proposed construction activities.
- Contain or lie adjacent to prime or locally-important wetlands.
- Be large enough to provide relatively unfragmented wildlife habitat or preservation of unique communities or buffers thereto.
- Provide potential use by the public as recreational or educational areas with accessibility, i.e., areas adjacent to existing established conservation tracts with public access.

As the NHDOT received input and feedback from communities and the agencies, numerous sites were compiled and investigated between early 2001 and the spring of 2002. In all, more than 60 sites comprising 7,000 acres of land were researched, visited, and assessed by NHDOT (see Table 4.6-4). A number of field visits were jointly undertaken with the resource agencies and/or local officials. Based on NHDOT's study, a mitigation package was proposed involving 11 sites and approximately 650 acres.

Simultaneously, the USEPA with assistance from NHDES, USFWS, Audubon Society and UNH Complex Systems Research Center undertook a study that would suggest locations of high environmental value, worthy of preservation in the south central region of New Hampshire (essentially the region designated as potentially being subject to secondary impacts). The study utilized Geographic Information Systems

**Table 4.6-4**
**Potential Wetland Mitigation Sites**

| Site ID # | Site Name | Town | Approximate Total Size | Creation (acres) | Preservation (acres) | Notable Site Features |
|---|---|---|---|---|---|---|
| 1 | Cohas Avenue Site | Manchester | 28.0 | 7.5 | 20.5 | Old sand/gravel pit. Abuts Cohas Brook. Good wetland creation potential. |
| 2 | Demers Site | Manchester | 25.0 | | 25.0 | Includes forested hillside and floodplain areas that abut Cohas Brook. |
| 3 | Filip Farm Site | Manchester | 35.0 | | 35.0 | Portion of Filip's Glen development deeded to Crystal Lake Preservation Association and other undeveloped lots. Open field and wetlands that abut Mosquito Brook and other Crystal Lake area parcels. |
| 43 | Crystal Lake Preservation Association Properties | Manchester | 6.0 | | 6.0 | Forested upland and wetland areas that abut Crystal Lake and lie adjacent to Filip Farm Site. |
| 44 | Giovagnoli Farm Property | Manchester | 20.0 | | 20.0 | Agricultural field that lies adjacent to Cohas Brook and connects to Great Cohas Swamp located to west. |
| 46 | Podsadowski Property - The Hill | Manchester | 34.0 | | 34.0 | Forested, hillside parcel provides important connection to other undeveloped and protected land areas. Source of groundwater recharge for Crystal Lake. |
| 47 | Greek Picnic Grounds | Manchester | 40.0 | | 40.0 | Hill top parcel that connects Crystal Lake area parcels to existing conservation lands. |
| 48 | Hackett Hill | Manchester | 140.0 | | 140.0 | Forested upland and wetland areas that abut existing nature reserve and contain wide variety of plant species and wildlife habitat. |

**Table 4.6-4 (continued)**

| Site ID # | Site Name | Town | Approximate Total Size | Creation (acres) | Preservation (acres) | Notable Site Features |
|---|---|---|---|---|---|---|
| 53 | Demers Property Easement | Manchester | 10.0 | | 10.0 | Conservation easement on existing undeveloped land to widen ecological corridor along Mosquito Brook. |
| 7 | Bob Evans Tree Farm | Londonderry | 220.0 | | 220.0 | Wide variety of wildlife habitat including forested areas, open field, open water and vegetated wetlands. |
| 14, 15 | South Road Mitigation Site | Londonderry | 75.0 | 11.0 | 64.0 | Advance Mitigation Site. Abuts Beaver Brook. Created wetlands and wildlife habitat restoration in design. |
| 58 | Scobie Pond Area | Londonderry | 310.0 | | 310.0 | Identified by Town of Londonderry as opportunity for preservation. |
| 59 | Reed Clark Corridor | Londonderry | 91.0 | | 91.0 | Identified by Town of Londonderry as opportunity for preservation. |
| 60 | Little Cohas Brook Area | Londonderry | 60.0 | | 60.0 | Identified by Town of Londonderry as opportunity for preservation. |
| 61 | Musquash Expansion Parcels | Londonderry | 372.0 | | 372.0 | Identified by Town of Londonderry as opportunity for preservation. |
| 62 | Bockes Forest Expansion | Londonderry | 103.0 | | 103.0 | Identified by Town of Londonderry as opportunity for preservation. |
| 16 | Sybiak Farm Property | Derry | 198.0 | | 198.0 | Wide variety of wildlife habitat including upland forest, abandoned farm field/orchards and prime wetlands. Adjacent to proposed bike path. |
| 17 | Castle Reach | Windham | 382.0 | | 382.0 | Forested areas adjacent to Mitchell Pond. Under imminent development pressure. |

## Table 4.6-4 (continued)

| Site ID # | Site Name | Town | Approximate Total Size | Creation (acres) | Preservation (acres) | Notable Site Features |
|---|---|---|---|---|---|---|
| 18 | Nassar Property | Windham | 79.0 | | 79.0 | Hilly wooded and open terrain with trails and pond. Adjacent to Flat Rock Brook. |
| 19 | Nassar Property "Back orchard" | Windham | 21.0 | | 21.0 | Active agricultural operation. |
| 24 | Highway Median | Windham | 17.0 | Possible | | Located within existing highway median. Possible wetland creation and restoration. Wellhead protection district adjacent to existing NHDOT mitigation site. |
| 49 | Armstrong Property (Cobbetts Pond Site) | Windham | 11.0 | | 11.0 | Adjacent to existing NHDOT creation site. Wellhead Watershed Protection District located on site. |
| 51 | Flat Rock Brook Area | Windham | 300.0 | | 300.0 | Undisturbed contiguous tract of land adjacent to Flat Rock Brook. Wide variety of species and wildlife habitat. |
| 52 | Seavey Pond Area | Windham | 215.0 | | 215.0 | Forested upland and wetlands that border on Seavey Pond. Abuts existing conservation land. |
| 54 | North Flat Rock Brook Area | Windham | 650.0 | | 650.0 | Forested uplands and wetlands that border Flat Rock Brook tributaries. Abuts existing conservation land. |
| 55 | Searles Area Site | Windham | 102.0 | | 102.0 | Mostly forested areas with wide topographic relief. |
| 45 | Windham Southeast Lands | Windham | 950.0 | | 950.0 | Large, undisturbed, contiguous forested areas adjacent to Porcupine Brook and Golden Brook containing diversity of species and habitat. Some areas under development threat. Contains EPA-identified Heritage Site (NE Basin Swamp). |

**Table 4.6-4 (continued)**

| Site ID # | Site Name | Town | Approximate Total Size | Creation (acres) | Preservation (acres) | Notable Site Features |
|---|---|---|---|---|---|---|
| 50 | Brady Road Site | Salem | 18.0 | | 18.0 | Private residence and forested area recently cleared. Abuts Porcupine Brook, Eismont Property and Southeast Lands Site. |
| 30 | Cluff Crossing | Salem | 27.0 | Possible | | Flat open fields and prime wetlands. Wetland creation/enhancement and floodplain compensation. |
| 31 | Pelham Road Mitigation Site | Salem | 25.0 | 4.0 | 21.0 | Advance Mitigation Site. Abuts Porcupine Brook. Created wetlands complete. |
| 32 | Salem Wastewater Treatment Plant | Salem | 32.0 | Possible | | Abandoned buildings and plant components and second-growth areas. Flood storage compensation and hazardous waste remediation. |
| 33 | Garabedian Drive | Salem | 35.0 | Possible | | Cleared altered areas adjacent to Spickett River. Flood storage compensation and possible creation/restoration. |
| 35 | Keewaydin Reality Trust Property | Salem | 14.0 | | 14.0 | Forested area adjacent to Porcupine Brook (prime wetland). Flood storage compensation. |
| 36 | Public Works Garage | Salem | 7.0 | Possible | | Agricultural field adjacent to Policy Brook. Possible flood storage compensation and/or wetland creation. |
| 38 | Baggett Property | Salem | 6.0 | | 6.0 | Forested area adjacent to prime wetland. Flood storage and/or preservation (wildlife habitat). |
| 40 | Eismont Property | Salem | 61.0 | | 61.0 | Forested upland and abandoned farmstead with wetlands adjacent to Porcupine Brook. Site contiguous with Southeast Lands site. |

**Table 4.6-4 (continued)**

| Site ID # | Site Name | Town | Approximate Total Size | Creation (acres) | Preservation (acres) | Notable Site Features |
|---|---|---|---|---|---|---|
| 45a | Salem Southeast Lands | Salem | 64.0 | | 64.0 | Forested upland island surrounded by wetlands provides diverse wildlife habitat. Contiguous with Windham Southeast Lands. |
| 56 | Massabesic Lake/ Little Massabesic Lake Area Properties | Auburn | 1100.0 | Possible | 1100.0 | Mostly forested upland and wetland areas contiguous with Manchester Water Works properties, Massabesic Lake and the Spruce Lakes/Spruce Swamp area. Smaller areas of pasture and tree farms. Gravel pit for possible wetland creation. Preservation provides watershed protection in perpetuity. |
| 57 | Dubes Pond/Hinman Pond Area Properties | Hooksett | 1500.0 | | 1500.0 | Mostly forested upland and wetland areas contiguous with adjacent Manchester Water Works properties. Northern lots abut Bear Brook State Park. Preservation provides watershed protection in perpetuity. |

(GIS) mapping of natural resource data, existing conservation lands, and a large unfragmented land areas, and input from local conservation commissions, environmental professionals from state and federal agencies and environmental interest groups. Locations were rated in accordance with the degree of "co-occurrence" of multiple resources in a specific area and the priorities expressed by the participants. In general, emphasis was placed on areas with important natural resources, large (500 to 1,000-acre) conservation lands, and land areas providing continuity among wildlife corridors between large unfragmented land areas. From this study, the USEPA with concurrence from USFWS, NHDES and NHF&GD proposed their own mitigation package (see Appendix J). The package would include the NHDOT's proposed sites, and in addition another eight sites totaling 2,900+ acres, as well as making funding of an unspecified amount available for the purchase of additional sites over time, and funding for technical assistance to assist communities trying to cope with rapid growth and development. It should be noted that from the agencies' perspective, their mitigation package goes beyond offsetting the highway widenings' direct impacts to wetlands and natural areas, and provides mitigation to address the general issue of secondary impacts in the region served by I-93 (see Section 4.12).

## Proposed Wetland Mitigation Package

The wetland mitigation package proposed as part of the document is an attempt to address the direct impacts to wetlands and associated natural resources as result of highway and interchange construction. As previously discussed, the proposed package by NHDOT involves 11 sites and approximately 650 acres. The proposed package was developed under assumptions that the mitigation should:

- Primarily address direct impacts to wetlands, flood storage, and water quality.
- Be located within close proximity to project impacts, and to the extent practicable, within the five corridor communities which would absorb the majority of impacts associated with the highway widening.
- Be generally distributed within the corridor communities in accordance with the quality of the impacted resources within each community, and the overall magnitude of impact the project brings to bear on each community.
- Reflect the priorities of each community relative to mitigation with recognition of the direction provided by the Resource Agencies.
- Involve a reasonable expenditure of public funds.

Sites not proposed may either not address the needs listed above or may fall short for reasons as follows:

- Highly degraded or altered conditions.
- Comprised of nearly all wetland, therefore, unlikely to be developed.
- Comprised of nearly all upland, therefore habitat diversity is limited.
- Already protected by conservation easement or development restrictions.
- Not favored by particular agencies or concerned parties who may (or may not) have recommended alternate sites.
- Cost relative to value and/or suitability as mitigation site was exorbitant.

Specific descriptive site summaries are provided here for each component of the mitigation package. Sites are located within each of the five corridor communities: Salem, Windham, Derry, Londonderry, and Manchester **(Figure 4.6-2).**

### Salem

Sites proposed in Salem all contain a flood storage component to assist with the persistent flooding problems in the town, and to mitigate for lost flood storage due to proposed highway construction. In providing for flood storage, wetland creation/enhancement will be provided with benefits in terms of wildlife and water quality. Depending on which options are chosen, the total amount of wetland impacts (including bike path and sound walls) within Salem is approximately 24 acres. Total mitigation provided by the proposed sites amounts to 60 acres (including creation, preservation, and flood storage replacement elements). Each of the sites is described below.

**Pelham Road Mitigation Site (#31)** is an advance mitigation site previously described.

**Salem Wastewater Treatment Plant Site (#32)** is adjacent to the Spickett River. A portion of the site lies within existing floodplain. Although cleanup of the site (hazardous materials) would be necessary, the site is ideal for its flood storage potential and additional wetland creation area. The Town of Salem is in favor of the use of this site.

**Baggett Property (Site #38)** is located on NH 38 adjacent to the existing highway. Although only 6 acres in size, the site could provide critical flood storage and possibly additional created wetlands to tie into existing prime wetlands located south of the site.

#### Windham

Sites proposed in Windham provide wetland creation in close proximity to Canobie Lake and Cobbetts Pond, locations which have little remaining buffer areas to development. Other mitigation sites (Southeast Lands) provide preservation over a large number of properties. These sites were included on "co-occurrence" maps developed by USEPA and other agencies as previously discussed. As such, the Southeast Lands site was proposed in part in response to resource agency input. Depending on which options are chosen, the total amount of wetland impacts (including bike path and sound walls) in Windham is approximately 20 acres. Total mitigation provided by the sites in Windham would amount to nearly 270 acres (creation, preservation, and flood storage replacement). Each of the sites is described below.

**Highway Median Site (Site #24)** is located between the northbound and southbound lanes, south of NH 111A in the vicinity of Canobie Lake and Cobbetts Pond. This site is 17 acres in size and would become available should the tight shift option be constructed. Lying adjacent to a large area of emergent marsh, Site #24 would provide additional created wetland area in addition to flood storage.

**Armstrong Property (Site #49)** is located adjacent to an existing Windham-Salem Project Mitigation Site. As it lies in close proximity to Cobbetts Pond, the 11-acre property (under threat of development) would provide an important preservation buffer to the pond.

**Southeast Lands Area (Site #40, 45, 45a, 50)** is located primarily in the southeast corner of Windham, with a smaller portion located in Salem. The 250 acres proposed for preservation represents a core section of a larger area totaling about 1,100 acres that is currently undeveloped but under the immediate threat of development.

Consisting of large areas of wetland habitat interconnected with upland islands, the area provides largely unspoiled wildlife habitat, diverse plant communities, and buffering protection to forested, scrub/shrub and emergent marsh wetlands.

It should be noted that the Town of Windham is greatly interested in the I-93 project and has specific concerns and priorities relative to project mitigation. Beyond their genuine concern relative to water quality impacts to Cobbetts Pond and Canobie Lake, they note the substantial impacts to commercial industrial properties due to the needed improvements to Exit 3, and the tremendous development pressure being exerted as a corridor community. Preserving open space is a key priority with benefits foreseen relative to water quality, wildlife, recreation, limiting the tax burden, and general quality of life issues. In correspondence received in June 2002, the Town restated its preference regarding preservation as mitigation. Generally speaking the undeveloped land east of I-93 to the east of NH 28, involving 19 parcels and 1,700 acres has been requested for consideration. The lands include portions of the Flat Rock Brook wildlife corridor, lands abutting the abandoned railroad corridor, lands in the vicinity of Mitchell Pond and Seavey Pond. Further consideration will be given to utilizing these properties (or a portion thereof).

#### Derry

The site in Derry is a large preservation site of importance to the town and is under immediate threat of development. A mix of varied upland habitat (forested, open fields) and prime wetlands (emergent marsh, forested), the site provides an extensive area for use by wildlife. Continued public use of the site (via the abandoned railbed that bisects the property and serves as a recreational trail) was indicated as an important factor to the town. Depending on which options are chosen, the total amount of wetland impacts (including bike path and sound walls) in Derry is approximately 6 acres. Total mitigation provided by the site in Derry would amount to nearly 200 acres (preservation). The proposed mitigation site is described below.

**Sybiak Farm Property (Site #16)** is located east of I-93, and north of the Windham/Derry municipal boundary. The nearly 200-acre site consists of abandoned pastures and orchard, with mature forests situated on knolls. Extensive areas of emergent marsh and smaller areas of forested wetland provide a varied habitat for wildlife. Used recreationally by townspeople, with access provided to the site via an old rail corridor, the site is under imminent threat of development.

#### Londonderry

The site in Londonderry (South Road Mitigation Site) is an advance mitigation site in an existing gravel pit through which Beaver Brook passes. Depending on which options are chosen, the total amount of wetland impacts (including bike path and sound walls) in Londonderry is approximately 30 acres. Total mitigation provided by the site would amount to nearly 75 acres (10 to 15 acres creation and 60 to 65 acres of preservation). The site has also been identified a potential location for passive recreational use by townspeople.

**South Road Mitigation Site (Site #14 and 15)** is an advance mitigation site previously described.

### Manchester

The sites in Manchester provide wetland creation/enhancement and habitat protection on lands adjacent to Cohas Brook. The sites are near to the Massabesic Lake reservoir protection area, and provide some additional buffer area to the public water supply. Under the Preferred Alternative, the total amount of wetland impacts (including bike path and sound walls) in Manchester is approximately 4 acres. Total mitigation provided by the sites in Manchester would amount to about 50 acres (creation and preservation). The proposed mitigation sites are described below.

**Cohas Avenue Site (Site #1)** is located east of the highway near the northern project terminus between Cohas Avenue and I-93. The 28-acre parcel (an abandoned gravel pit) is adjacent to Cohas Brook and abuts Manchester Water Works property to the south (part of the Massabesic Lake reservoir protection area). Recommended by the city for protection of water supplies and passive recreation, the site also has the potential for approximately 7 acres of wetland creation.

**Demers Site (Site #2)** is located east of the highway and north of Bodwell Road. The site lays adjacent to/south of Cohas Brook and a portion of the site is currently being used as a staging area for materials associated with nearby construction activities and a rock crushing operation. The site, which is near the Massabesic Lake reservoir protection area, is a total of 25 acres and would be restored and enhanced to provide a protective buffer to the stream and wildlife habitat.

It should also be noted that the City, both through a local association and through city officials, has voiced strong support for preservation of undeveloped properties in the area of Crystal Lake. Preservation of such properties would benefit the Lake in terms of water quality and provide some open space for wildlife utilizing the Cohas Brook area as a wildlife corridor. Consideration will be given to selecting the Crystal Lake Area Properties described below and foregoing the proposed Cohas Avenue site and the Demers site.

**Crystal Lake Area Properties (Site #3, 43, 44, 46, 47, and 53)** are located to the north, west, and south of the lake. Some of the properties abut the lake provided important buffering functions to the lake. The properties are contiguous with one another and would provide a wildlife corridor extending from Crystal Lake to Great Cohas Swamp. With a variety of wetland and upland habitats, preservation of these areas would preserve many of the functions and values lost in other wetlands due to highway construction. The 130 acres (all parcels combined) are more suitable as preservation properties than wetland creation. Preservation of these remaining Crystal Lake parcels is a top priority of the Crystal Lake Preservation Association and has been endorsed by the Manchester Board of Aldermen.

#### 4.6.2.5 Wetlands Finding

Under Executive Order 11990, Federal actions (in which impacts to wetlands are unavoidable) require a "finding" that there are no practical alternatives to the proposed construction in wetlands and that the proposed action included all practical means to reduce harms to wetlands. This analysis will be considered and provided within the Final EIS after the Selected Alternative in chosen.

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### 4.6.3 Vernal Pools

Impacts to vernal pools are associated with both the Three-Lane and Four-Lane Alternatives and construction of the bike path. More specifically one vernal pool (VP13) would be filled to some extent by both alternatives (Three-Lane and Four-Lane). Two additional vernal pools (VP20 and VP21) would be impacted (or not) to varying amounts depending on which alternative is constructed. Additionally construction of the bike path would result in impacts to another vernal pool (VP15a).

Other than VP 13 and to a lesser extent VP15a, adjacent upland habitat is largely unaffected by the highway widening activities. Most vernal pool and upland habitat appears to be located at least 200 feet from the edge of the roadway. All impacted vernal pools are located within existing mapped wetlands. The areal extent (acres) of impacts to wetlands, in which the vernal pools are located, is described in Section 4.6.2.

#### 4.6.3.1 Impact Methodology

Impacts to vernal pools were determined by overlaying the alternative designs on a map showing field-reviewed wetlands and biological resources (**Figure 3.6-4**) to determine whether an area would be impacted or not. Specific (numbered) vernal pools identified as being impacted by the project are listed for both the Three-Lane and Four-Lane Alternatives by segments, A through F.

#### 4.6.3.2 Build Alternatives

Impacts associated with each Build Alternative are described below by highway segment.

<u>**Three-Lane Alternative**</u>

**Segment A**

There are no vernal pools located within Segment A. Therefore, no impacts would occur due to construction of the Three-Lane Alternative in these segments.

### Segment B

There are no vernal pools located within Segment B. Therefore, no impacts would occur due the Three-Lane Alternative in Segment B.

### Segment C

There are no vernal pools located within Segment C. Therefore, no impacts would occur due the Three-Lane Alternative in Segment C.

### Segment D

All Exit 3 options (1 through 9) in Segment D for the Three-Lane Alternative will impact one vernal pool (VP13), located within the highway median. The Three-Lane Alternative results in approximately 750 square feet, or fifty percent of the areal extent of the pool being filled. Loss of fifty percent of vernal habitat would have presumed loss of fifty percent of the breeding capacity of the vernal pool. Sufficient area exists adjacent to the pool to allow construction of lost habitat. Vernal Pool 13 has limited use by breeding amphibians, probably due to inadequate upland habitat around the pool, and apparent water quality degradation. Vernal pools VP6, VP15a, VP18, and VP22 (all located within Section D) will not be impacted by the Three-Lane Alternative options.

### Segment E

Impacts to VP20 and VP21 will occur with the east option of the Three-Lane Alternative. This design option results in impacts to the western edges (that currently exhibit signs of habitat degradation, i.e. filamentous algae, trash) of the pools amounting to approximately 2,000 square feet, or twenty percent of VP20 and 1,000 square feet, or five percent of VP21 being filled. As conceptually designed, the proposed detention basin to be located between VP20 and VP21 is not expected to have a direct effect on the functioning of the vernal pools. Drainage from the basin will not be directly discharged into either vernal pool. Construction of the basin would not appear to present a physical barrier to vernal pool species. In addition, upland habitat is extensive in the areas adjacent to the vernal pools, so construction of the basin would entail little loss of habitat. With the west option, no impacts to vernal pools would occur, although the west option would have impacts to wetlands located on the west of the highway.

### Segment F

There are no vernal pools located within Segment F. Therefore, no impacts would occur due the Three-Lane Alternative in Segment F.

## Four-Lane Alternative

### Segment A

There are no vernal pools located within Segment A. Therefore, no impacts would occur due to construction of the Four-Lane Alternative in these segments.

### Segment B

There are no vernal pools located within Segment B. Therefore, no impacts would occur due the Four-Lane Alternative in Segment B.

### Segment C

There are no vernal pools located within Segment C. Therefore, no impacts would occur due the Four-Lane Alternative in Segment C.

### Segment D

Options (1 through 9) for Exit 3 will impact one vernal pool (VP13), located within the highway median under the Four-Lane Alternative. The Four-Lane Alternative results in approximately 1,350 square feet, or ninety percent of the areal extent of the pool being filled. Impacts to this extent would likely eliminate the functioning of this area as a vernal pool. Remaining portions of the pool could be extended in adjacent area to the west to recreate vernal pool habitat (see Section 4.6.2.4). Vernal Pool 13 has limited use by breeding amphibians, probably due to inadequate upland habitat around the pool and water quality degradation. Vernal pools VP6, VP15a, VP18,and VP22 (all located within Section D) will not be impacted by the Four-Lane Alternative options.

### Segment E

Impacts to VP20 and VP21 will occur with the east option of the Four-Lane Alternative. This design option results in impacts to the western edges (that currently exhibit signs of habitat degradation, i.e., filamentous algae, trash) of the pools amounting to approximately 3,000 square feet, or thirty percent of VP20 and 3,000 square feet or fifteen percent of VP21 being filled. With the west option, no impacts to vernal pools would occur, although the west option would have impacts to wetlands located on the west of the highway (see Section 4.6.2).

### Segment F

There are no vernal pools located within Segment F. Therefore, no impacts would occur due the Four-Lane Alternative in Segment F.

### Four-Lane/Three-Lane Combination

A third alternative is the combination of 4 lanes beginning at the state line and extending through Exit 3 and then switching to 3 lanes after Exit 3 to the I-93/I-293 split in Manchester. Since the same vernal pools are affected by Three-Lane and Four-Lane Alternatives, the Four-Lane/Three-Lane Combination would affect the same vernal pools as either alternative constructed separately (i.e., one pool in Segment D, and none or two pools depending on whether the west or east widening option is selected in Segment E).

### Bike Path

Construction of the bike path with either the Three-Lane or Four-Lane Alternative will impact approximately 3,000 square feet of VP15A. Approximately 3,000 square feet of VP20 and VP21 will be impacted with construction of the Segment E east option; these would be avoided if the west option is constructed.

### Sound Walls

The construction of sound walls will not impact vernal pools within the project corridor.

### 4.6.3.3 No–Build Alternative

The No-Build Alternative would not affect vernal pools since there would be no new construction.

### 4.6.3.4 Mitigation

All impacted vernal pools are included within mapped wetland areas within the corridor. Mitigation for impacts to vernal pools is discussed in Section 4.6.2.4 (Compensatory Wetland Mitigation).

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## 4.6.4 Wildlife Resources

### 4.6.4.1 Short-Term versus Long-Term Impacts

Highway construction has both short-term and long-term impacts on wildlife habitats and populations. Short-term impacts are directly related to disturbance caused by construction activities and include the construction footprint, as well as increased noise and visual disturbance from land-clearing, earth moving, construction machinery, and the presence of humans. Long-term impacts include the permanent loss of wildlife habitat, and can involve, in the case of new roads on new location, long-term changes in the availability and types of habitat, including loss of connectivity between types and increasing fragmentation of large habitat blocks.

Direct mortality due to construction impacts will most likely occur for fossorial (burrowing) mammals, reptiles and amphibians, and breeding animals and their young, whose dens or nests are destroyed by the clearing and grading. More mobile animals may move to other habitats when disturbed by construction. These animals may find habitat that has sufficient food and cover to support them if adjacent habitats are not already at carrying capacity. Those animals that are unable to locate sufficient food, cover or space may fail to breed successfully, be forced to wander further, or eventually die.

Many animal species habituate to continuous noise, including traffic noise from highways; however, sudden loud noises, such as construction noise, can be more of a disturbance (Busnel 1978). Wildlife using habitats near I-93 are tolerant of traffic noise, but could be sensitive to construction noise and activities. Loud noises associated with construction could mask territorial vocalizations of species living near the highway, at least temporarily interfering with breeding (Busnel 1978).

Sudden changes in habitat types and quality due to construction can have important effects on wildlife, especially if these changes occur during critical periods. Disturbance of breeding habitat during the breeding season and while young are being reared can reduce or prevent successful reproduction. Disturbance during severe winter weather may force wildlife from protective cover which can result in lower reproductive rates and increased mortality.

Studies have shown that some species of birds, including blue jay, winter wren, Nashville warbler, bay-breasted warbler, blackburnian warbler, and savannah sparrow (Ferris 1977, Adams and Geis 1981), and some mammals, such as red-backed vole and fisher (Palman 1977), tend to avoid habitats adjacent to highways. Others are attracted to the roadside vegetation or the highway opening and tend to occur more frequently near a highway than in the adjacent forests. These species include: American robin, chestnut-sided warbler, common yellowthroat, eastern meadowlark, white-throated sparrow, indigo bunting, red fox, coyote, rabbit, and woodland jumping mouse (Ferris 1977; Palman 1977; Michael 1975, and Adams and Geis 1981). Other species may be temporarily attracted to the roadside edge for opportunistic reasons such as salt (deer and moose) or road kills (crows and vultures).

Impacts to amphibians, reptiles and small mammals would be anticipated since these species generally have small home ranges, which may be totally eliminated with highway widening. Potential impacts to medium-sized and large mammals would generally be less severe due to the larger home ranges associated with these species and their ability to move to other habitats nearby. However, in those cases involving reduction in habitat connectivity, the impacts may make such movements difficult with long-term effects on the local population's viability.

Increasing the number of highway lanes can increase wildlife mortality due to potential collisions with vehicles as animals attempt to cross a wider highway. The ease with which some wildlife can cross a highway also varies with median widths. Wide medians can provide a refuge for individuals attempting to cross multiple highway lanes. Nonetheless, highway mortality is generally not a threat to species' populations levels (Leedy and Adams 1982) except when populations are already low or when the highway is near a critical habitat. Breeding amphibians like mole salamanders and wood frogs require vernal pool areas for breeding and any widening that makes migration to these habitats more difficult may have serious consequences on the local populations. In general, vehicle collisions with larger species of wildlife, like deer and moose, pose a far greater risk to human safety than to the wildlife populations.

Riparian corridors, i.e., areas along streams or other water bodies, are important wildlife habitats and are often used as travel corridors by wildlife. Noss (1987) noted that riparian corridors help to maintain the natural connectivity of habitats that would otherwise be fragmented by development. Minimizing impacts to existing riparian travel corridors is important for protecting these valuable habitats and reducing indirect wildlife impacts.

In a written response from NHF&GD during project scoping, the agency stated that "…initial construction of I-93 fragmented wildlife habitats and travel corridors, that further widening of I-93 would further fragment these habitats and disrupt remaining corridors, and that all these impacts should be considered in the EIS."
Of the various ways highways and their construction can adversely affect wildlife, the widening of a freeway would have less impact than the original construction of the facility. Widening projects typically impact edge areas of previously disturbed wildlife habitat. As such, the issues of fragmentation, severing of wildlife corridors, separating breeding areas from non-breeding areas, etc. are typically of less concern with highway-widening type projects. Of concern with a widening type project are additional impacts to sensitive habitat areas and potential increases in road kill. Areas where such concerns potentially exist along the project corridor include the heron rookery north of Exit 3 and a number of vernal pools lying just off the edge of the highway.

The amount of habitat loss varies among the various project alternatives and options. These differences can be used as one measure of the relative merit of each option or alternative. The following section describes the specific habitat impacts associated with the project.

### 4.6.4.2 Build Alternatives

The percentage of each major cover type or land use along the corridor was estimated by visual inspection: wetlands 20%, upland forest and shrubland 30%, agriculture 10%, mowed highway edge 15%, and residential or commercial development 25% (**Figure 3.11-1**, Land Use). These average percentages were used to estimate the amount of habitat directly affected by the proposed improvements.

### Three-Lane Alternative

Depending on the various options selected for the interchange configurations and other design choices, the Three-Lane Alternative will convert approximately 170 to 220 acres of land outside the existing right-of-way. Useable wildlife habitat in the form of wetlands, upland forest and shrubland, and agricultural fields or orchards make up an estimated 60 percent (102 to 132 acres) of the total conversation.

The total area of disturbance both inside and outside the State's existing right-of-way for the Three-Lane Alternative is estimated to be 275 to 350 acres. The direct loss of wetland habitat will range from 55 to 70 acres (see Section 4.6.2). Upland habitat disturbance (i.e., upland forest, shrubland and agriculture) will be on the order of an additional 110 to 140 acres.

### Four-Lane Alternative

Depending on the various options selected for the interchange configurations and other design choices, the Four-Lane Alternative will convert approximately 225 to 290 acres of land outside the existing right-of-way. An estimated 60 percent (135 to 175 acres) of this is useable wildlife habitat, i.e., wetland, upland forest and shrubland, or agriculture.

The total area of disturbance both inside and outside the State's existing right-of-way for the Four-Lane Alternative is estimated to be 300 to 375 acres. The direct loss of wetland habitat will range from 60 to 75 acres (see Section 4.6.2). Upland habitat disturbance will be on the order of an additional 120 to 150 acres.

### Four/Three-Lane Combination Alternative

A third alternative is the combination of widening to 4 lanes beginning at the state line and extending north through Exit 3 and then switching to 3 lanes after Exit 3 to the I-93/I-293 Interchange split in Manchester. The total area of disturbance is estimated to be 300 to 350 acres with this alternative. Of this total, approximately 60 to 70 acres will be wetland impacts and 120 to 140 acres upland habitat impacts.

### Bike Path

The bike path, regardless of the alternative it is associated with, will not add appreciably to the amount of habitat disturbance or direct loss (estimated to be about 30 acres) resulting from the project.

### Park and Rides

Additional impacts on wildlife habitat with the proposed park and ride lots will range from about 27 to 30 acres depending on the locations chosen.

### Sound Wall

The sound wall placements will have no appreciable effect on wildlife habitat in the project area, but may serve as a barrier to movements of animals across the highway. None of the barriers is situated at any known important travel corridor locations, however.

## 4.6.4.3 No-Build Alternative

The No-Build Alternative will not result in any new impacts on wildlife resources, since there would be no new construction.

## 4.6.4.4 Mitigation

A number of measures are available to mitigate for impacts to wildlife resources. In particular, impacts to wetland habitats will require compensatory mitigation in the form of wetland restoration, enhancement, creation or preservation (see Section 4.6.2). In terms of wildlife in general over the long term, preserving relatively large parcels of land would be more beneficial than creating numerous small, roadside mitigation areas. Where wetland creation is proposed, in part to address impacts on wildlife functions, good interspersion of wildlife food and cover will be important. Such steps have been incorporated into the design of the advanced wetland mitigation sites in Salem (Pelham Road) and Londonderry (South Road). A diverse group of native wetland plant species is typically planted to create a high structural and plant species diversity attractive to a wide variety of wildlife. Preservation of existing wetlands, including vernal pools, and their surrounding uplands, that are threatened by development, will also have substantial benefits to wildlife over time.

Existing riparian corridors currently used by wildlife as travel-ways are not anticipated to be impacted in a substantive way by the widening project. Where culverts and bridges at the major stream crossings, such as Cohas Brook, Beaver Brook, and Porcupine Brook (see Section 4.4.2), are in need of replacement due to age and condition, consideration will be given to replacing the structures with structures of larger openings, and/or natural bottoms as appropriate to better provide for wildlife movements.

Several additional measures will be taken during construction to reduce impacts on wildlife habitat. The amount of land cleared of vegetation will be limited as practical. This will be important in areas where there are currently only narrow buffer strips between the highway and other human development. Re-vegetation of the land disturbed by construction activities will take place as soon as possible after construction is completed, so that erosion is minimized, and in doing so wildlife habitat and other values will be restored. Brush clearing or tree thinning in forests adjacent to the construction areas will not be proposed. Where feasible and safe, snags (i.e., dead standing trees) will be maintained adjacent to the mowed sections of the right-of-way in order to provide perch sites, nesting cavities, and den sites for wildlife.

Maintenance of the highway right-of-way to provide clear zone areas will be limited to the degree practical. On the one hand, maintaining large swaths of open areas are expensive and not beneficial to wildlife. On the other hand, providing clear zones for motorist's safety and discouraging wildlife from approaching the highway will be important.

## 4.7 Threatened and Endangered Species

Based on information provided by the New Hampshire Natural Heritage Inventory (NHNHI), the NHF&GD, the USFWS and the NH Audubon Society, one population of a state-listed threatened plant may be affected by the project, as discussed below.

### 4.7.1 Plants

#### 4.7.1.1 Federal Endangered and Threatened Plant Species

While four federally listed threatened or endangered plant species occur in New Hampshire, no known populations are located within the study area. Therefore, no federally listed endangered or threatened plant species will be affected by any of the proposed project alternatives.

#### 4.7.1.2 NH Endangered and Threatened Plant Species

One population of the perennial wildflower wild lupine (*Lupinus perennis*) is located within 15 feet from the travel lane on the west side of I-93 between Exits 1 and 2 within the currently maintained right-of-way. The population is relatively small, with eight small colonies present in the open area between the roadway and an adjacent wooded area. This plant, listed by the NHNHI as a state-threatened species, is found at only 28 known sites in New Hampshire. Although considered rare in New Hampshire, this plant species is globally secure since it is demonstrably widespread and secure throughout its larger range, which extends throughout the northern plains to eastern Minnesota and south along the Atlantic Coast to Virginia. The plant is noteworthy because it is the sole larval food source for the federally listed endangered Karner Blue Butterfly (*Lycaeides melissa samuelis*), which is now thought to be extirpated from New Hampshire. Note that there is no known Karner Blue habitat in the vicinity of the lupine population.

Methods to mitigate impacts to this population are discussed in Section 4.7.3 below.

## 4.7.2 Wildlife

### 4.7.2.1 Federal Endangered and Threatened Wildlife Species

Based on information received from the USFWS, nine wildlife species are federally listed as endangered or threatened in New Hampshire. With the exception of occasional, transient threatened bald eagles (*Haliaetus leucocephalus*), however, no known populations occur within the project area. In their review of the project, the USFWS expressed the opinion that the project would have no direct effects on eagles (M. Bartlett, USFWS, letter dated June 12, 2002; Appendix E).

It is uncertain whether the project will impact the New England cottontail (*Sylvilagus transitionalis*). This species is not currently listed, but is identified by the USFWS as a conservation concern and therefore a candidate for listing (M. Bartlett, USFWS, letter dated June 12, 2002; Appendix E). It is unknown whether this species occurs in the project corridor, although potential habitat does appear to occur. An investigation will be done prior to the completion of the FEIS. If the species is found in the study area, further coordination with USFWS will be undertaken.

### 4.7.2.2 NH Endangered and Threatened Wildlife Species

Correspondence from the NHNHI (Appendix E) identifies the eastern hognose snake (*Heterodon platyrhinos*) as the only known state listed wildlife species in the project vicinity. The actual location of this population is believed to be more than 600 feet from the project. Therefore, no state listed endangered or threatened wildlife species is expected to be impacted by any of the proposed project alternatives.

## 4.7.3 Mitigation

Only the No-Build Alternative avoids direct impacts to the population of wild lupine (*Lupinus perennis*) located near Exit 2. Because of its close proximity to the traveled way, all of the Build Alternatives will completely impact this population.

Efforts to mitigate for this impact will focus on relocating these individuals by means of re-seeding or transplantation. To effectively accomplish this, a written mitigation plan specific to this population will be completed in consultation with the NHNHI prior to construction. This plan will address: information on the biology and environmental requirements of wild lupine, an evaluation of other transplantation attempts in the northeast, possible collection of seed material from this population, timing and methods for the relocation, and selection of the transplant location.

## 4.8 Noise Impacts

The noise analysis predicted future sound levels for approximately 1,050 receptor locations in the study area, using the noise contour maps. These receptor locations included residential and commercial properties. This analysis predicted changes in sound levels from the existing conditions to the 2020 No-Build and Build conditions.

### 4.8.1 2020 No-Build Alternative

The receptor locations along the existing I-93 corridor are predicted to experience 2020 No-Build Alternative peak sound levels that are similar to the existing conditions. This is the case because the highest sound levels are generated by the combination of traffic volumes, vehicle speeds, and truck percentages. While traffic volumes will increase over time, higher volumes will result in lower vehicle speeds. Therefore, the optimum combination of traffic volumes, vehicle speeds, and truck percentages that generates the highest roadway sound levels in the future will be similar to the sound levels being generated today. There may be more hours with the peak period sound levels, but the actual sound levels will be similar to the existing conditions.

The 2020 No-Build Alternative sound levels will vary from 48 to 71 dBA. Table 4.8-1 presents the predicted sound levels for 2020 No-Build Alternative.

### 4.8.2 Alternatives Evaluated

Chapter 2 presents a discussion of the evaluation of alternatives that were considered and presents the alternatives that were recommended for further evaluation. The noise analysis is based on I-93 being widened to four lanes in each direction, which is the preferred alternative and represents a worst case condition. The alternative to widen I-93 to 3-lanes in each direction would result in only a moderate reduction in noise levels with few if any modifications to the recommendations for noise mitigation. The I-93 northbound and southbound lanes have different characteristics for AM and PM peak periods. The noise analysis used the PM peak period traffic conditions to evaluate the receptor locations nearest to the northbound lanes and the AM peak period traffic conditions to evaluate the receptor locations nearest to the southbound lanes.

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### 4.8.3 2020 Build Alternative

The 2020 Build Alternative represents a worst-case condition for each receptor location, as discussed in Section 4.8.2. The 2020 Build Alternative sound levels are predicted to vary from 49 to 75 dBA, which represents up to a 5 dBA increase in sound levels as compared to the existing conditions. This increase is due to the combination of higher peak period traffic volumes, additional roadway capacity, and roadway alignment. Table 4.8.-1 presents the predicted sound levels for 2020 Build Alternative.

**Table 4.8-1**
**2020 Sound Levels (dBA)**

| Receptor Location[1] Number | Receptor Type | Receptor Location | 2020[2] No-Build Alternative | 2020 Build Alternative |
|---|---|---|---|---|
| Location 1 | Residential | Hanson Avenue. – Salem | 61 to 71 | 64 to 75 |
| Location 2 | Residential | Valeska Lane. – Salem | 56 to 70 | 61 to 73 |
| Location 3 | Residential | Cross Street. – Salem | 62 to 68 | 63 to 73 |
| Location 4 | Residential | McLarnon Road – Salem | 59 to 66 | 60 to 68 |
| | Commercial | Cross Street – Salem | 64 to 68 | 65 to 69 |
| Location 5 | Residential | Woodland Terrace – Salem | 58 to 67 | 58 to 71 |
| | Commercial | S. Policy St / Raymond Ave – Salem | 56 to 67 | 57 to 71 |
| Location 6 | Residential | Lowell Road - Salem | 60 to 68 | 60 to 72 |
| | Commercial | Keewaydin Drive – Salem | 57 to 66 | 58 to 68 |
| Location 7 | Residential | Brookdale Road – Salem | 60 to 70 | 60 to 73 |
| Location 8 | Residential | May Lane Drive – Salem | 59 to 67 | 60 to 68 |
| | Commercial | Manor / Industrial Parkway – Salem | 54 to 68 | 55 to 69 |
| Location 9 | Residential | South Shore Road – Windham | 66 to 70 | 67 to 72 |
| Location 10 | Residential | Squire Armour Road – Windham | 48 to 65 | 49 to 66 |
| Location 11A | Residential | Wildwood Road – Windham | 58 to 68 | 59 to 70 |
| Location 11B | Residential | Wildwood Road – Windham | 58 to 68 | 52 to 58 |
| Location 12A | Residential | Route 111A – Windham | 58 to 66 | 58 to 68 |
| Location 12B | Residential | Route 111A – Windham | 58 to 66 | 58 to 68 |
| Location 13A | Residential | West Shore Road – Windham | 57 to 61 | 58 to 62 |
| Location 13B | Residential | West Shore Road – Windham | 57 to 61 | 53 to 58 |
| Location 13 Center A | Residential | Between I-93 travel lanes – Windham | 55 to 60 | 58 to 62 |
| Location 13 Center B | Residential | Between I-93 travel lanes – Windham | 55 to 60 | 62 to 64 |
| Location 14 East | Residential | Gov. Dinsmore Road – Windham | 54 to 64 | 55 to 65 |
| Location 14 | Residential | Country Road – Windham | 58 to 68 | 59 to 70 |

## Table 4.8-1 (continued)

| Receptor Location[1] Number | Receptor Type | Receptor Location | 2020[2] No-Build Alternative | 2020 Build Alternative |
|---|---|---|---|---|
| Location 15 | Residential | Morrison Road – Windham | 58 to 66 | 58 to 67 |
| Location 16 | Residential | Spinnaker Drive – Derry | 51 to 65 | 51 to 66 |
| Location 17 | Residential | Tracy Drive – Derry | 52 to 66 | 54 to 68 |
| Location 18 | Residential | Fordway Extension - Derry | 57 to 69 | 58 to 71 |
| Location 19 | Residential | Mathew Drive - Derry | 55 to 66 | 58 to 68 |
| | Commercial | Kendall Pond Road - Derry | 60 to 66 | 62 to 68 |
| Location 20 | Residential | Charleston Avenue - Londonderry | 52 to 66 | 55 to 69 |
| Location 21 | Residential | Reo Lane - Londonderry | 58 to 66 | 60 to 68 |
| | Commercial | Londonderry Road - Londonderry | 58 to 66 | 60 to 70 |
| Location 22 | Residential | Ash Street - Londonderry | 62 to 66 | 65 to 70 |
| Location 23 | Residential | Trolley Car Lane - Londonderry | 59 to 66 | 60 to 68 |
| Location 24 | Residential | Seasons Lane - Londonderry | 56 to 70 | 57 to 71 |
| Location 25 | Residential | Rockingham Road - Londonderry | 49 to 66 | 52 to 69 |
| Location 26 | Residential | Perkins Road - Londonderry | 49 to 62 | 51 to 63 |
| Location 27 | Residential | Newton's Meadow Way - Manchester | 54 to 67 | 56 to 69 |
| Location 28 | Residential | Bodwell Road - Manchester | 50 to 68 | 51 to 69 |
| Location 29 | Residential | Cohas Avenue - Manchester | 50 to 67 | 51 to 68 |

Source: VHB, Inc.

1 See Receptor Locations and Sound Level Contours in **Figures 3.8-1 to 3.8-23**.

2 See Section 4.8.1 for discussion of why 2020 No Build Sound Levels are similar to 2000 Existing Sound Levels. The Noise Abatement Criteria are presented in Table 3.8-2.

## 4.8.4 Mitigation

Noise mitigation measures were evaluated for receptor locations, where noise impacts have been identified. The primary mitigation measure considered for noise abatement for this project was a noise barrier. Noise barriers provide noise abatement by reducing the transmission of sound waves. This is accomplished by shielding receptor locations from the noise source by blocking the line of sight. Noise barriers are judged as effective when they achieve a 5 to 10 dBA or greater noise reduction for the critical receptor locations with noise impacts.

Noise mitigation measures were evaluated for receptor locations that were predicted to have adverse noise impacts. Adverse noise impacts are defined as receptor locations with 2020 Build Alternative sound levels that approach (within one decibel), are at or exceed the FHWA Noise Abatement Criteria (NAC) as described in Table 3.8-2, which is 67 and 72 dBA for residential and commercial areas respectively; or when the predicted sound levels exceed the existing sound levels by

15 dBA or greater. Table 4.8-2 presents the locations where noise mitigation measures are being proposed.

Noise abatement is not always possible or practical at all impacted receptor locations. In order for noise abatement measures to be considered, the following criteria must be met:

- The receptor locations must have predicted sound levels resulting in adverse noise impacts;
- The noise abatement measure must be able to provide a reasonable reduction (at least 5 dBA) in sound levels;
- The noise abatement measure must be cost effective;
- The noise abatement measure must be feasible to construct; and
- The noise abatement measure should not have substantial impact on other resources, such as wetlands, historic buildings, and endangered species.

The following noise abatement measures can reduce traffic noise impacts, but are not proposed as noted below:

- Traffic management measures, which could include specified vehicle restrictions and modified speed limits. These measures are not consistent with the project goals.
- Alteration of horizontal and vertical alignments. To the degree this is practical, this was a consideration. However within the constraints and goal for this project, substantial alterations of highway geometry solely to minimize noise is not feasible.
- Acquisition of property (such as a buffer zone). NHDOT Policy precludes purchasing homes and businesses solely on the basis of noise impacts.

A detailed discussion of the noise barrier recommendations for all locations is provided in the Noise Barrier Data memo, which is presented in Appendix F. Sound Level Contours graphically display both the 60 and the 66 dBA levels as well as proposed noise barrier and privacy fence locations. The Sound Level Contours Figures are located in Volume 2 (Figures 3.8-1 through 3.8-23).

## Table 4.8-2
## Noise Mitigation Locations Based on 2020 Four-Lane Alternative

| Receptor-Location Number | Receptor Location | Number of Receptors that Approach or Exceed the NAC | Number of Residences w/ a 5 dBA or Greater Reduction | Noise[1] Barrier Recommended |
|---|---|---|---|---|
| Location 1 | Hanson Avenue. – Salem | 77 | 90 | Yes |
| Location 2 | Valeska Lane. – Salem | 6 | 7 | No |
| Location 3 | Cross Street. – Salem | 6 | 6 | No |
| Location 4 | McLarnon Road – Salem | 19 | 22 | Yes |
| | Cross Street – Salem | 0 | NA | No |
| Location 5 | Woodland Terrace – Salem | 12 | 16 | No |
| | South Policy Street - Salem | 3 | NA | No |
| Location 6 | Lowell Road – Salem | 20 | 26 | Yes |
| | S. Policy St / Raymond Ave - Salem | 0 | NA | No |
| Location 7 | Brookdale Road – Salem | 10 | 15 | Yes |
| Location 8 | May Lane Drive – Salem | 7 | 19 | Yes |
| | Manor / Industrial Parkway - Salem | 0 | NA | No |
| Location 9 | South Shore Road – Windham | 14 | 14 | Yes |
| Location 10 | Squire Armour Road – Windham | 1 | 3 | No |
| Location 11A | Wildwood Road – Windham | 8 | 18 | Yes[3] |
| Location 11B | Wildwood Road – Windham | 0 | 0 | No |
| Location 12A | Route 111A – Windham | 4 | 6 | No[3] |
| Location 12B | Route 111A – Windham | 4 | 6 | No[2] |
| Location 13A | West Shore Road – Windham | 0 | 0 | No |
| Location 13B | West Shore Road – Windham | 0 | 0 | No |
| Location 13 Center A | Between I-93 travel lanes – Windham | 0 | 0 | No |
| Location 13 Center B | Between I-93 travel lanes – Windham | 0 | 0 | No |
| Location 14 East | Gov. Dinsmore Road – Windham | 0 | 0 | No |
| Location 14 | Country Road – Windham | 3 | 6 | No |
| Location 15 | Morrison Road – Windham | 4 | 4 | No |
| Location 16 | Spinnaker Drive – Derry | 4 | 16 | No |
| Location 17 | Tracy Drive – Derry | 2 | 7 | No |
| Location 18 | Fordway Extension – Derry | 2 | 4 | No[2] |
| Location 19 | Matthew Drive – Derry | 14 | 26 | Yes |
| | Kendall Pond Road - Derry | 0 | NA | No |
| Location 20 | Charleston Avenue – Londonderry | 12 | 25 | No[2] |
| Location 21 | Reo Lane – Londonderry | 3 | 4 | No |
| | Londonderry Road - Londonderry | 0 | NA | No |
| Location 22 | Ash Street – Londonderry | 2 | 3 | No |
| Location 23 | Trolley Car Lane – Londonderry | 23 | 28 | Yes |
| Location 24 | Seasons Lane – Londonderry | 10 | 19 | Yes |
| Location 25 | Rockingham Road – Londonderry | 2 | 2 | No[2] |
| Location 26 | Perkins Road – Londonderry | 0 | 0 | No |
| Location 27 | Newton's Meadow Way – Manchester | 21 | 36 | Yes |
| Location 28 | Bodwell Road – Manchester | 15 | 27 | Yes |
| Location 29 | Cohas Avenue – Manchester | 11 | 14 | No |

Source: VHB, Inc.

1 Noise barrier evaluations are presented in Appendix F.
2 Privacy Fence Proposed.
3 Does not represent the Preferred Alternative.

### 4.8.5 Construction Noise Impacts

Noise impacts from construction activities are closely related to the phase of construction and the type and placement of construction equipment at the site. Table 4.8-3 shows a variety of construction equipment that may be deployed at various stages of highway construction. Typical noise levels from this equipment are also shown.

Construction activities would result in a substantial but temporary noise impact to receptors at various locations adjacent to proposed construction. Noise levels would vary depending on the type and number of pieces of equipment active at any one time. It is expected that noise levels exceeding 67 decibels could occur up to 500 feet away from construction activities. In general, construction noise would be restricted to daylight hours, although night construction will be required given the need to maintain traffic in both directions much of the time during daylight hours.

In an effort to minimize construction noise, proposed noise barriers will be built as soon as possible so that they may provide a reduction in subsequent construction noise to the residences. However, at some locations (such as Location 6, Lowell Road in Salem) the noise barrier will need to be the last phase of construction due to the location of temporary detour roadway.

Bridge construction represents a source of higher noise levels due to pile driving and other activities. Major bridge construction is planned for the following locations:

- Cross Street (over I-93 NB & SB)
- I-93 Exit 1 SB On & Off Ramps (over I-93 NB & SB)
- I-93 Exit 1 SB On Ramp (over South Policy Street)
- I-93 NB & SB (over Lowell Road, NH 38)
- I-93 NB & SB (over Porcupine Brook)
- I-93 NB & SB (over Pelham Road, NH 97)
- I-93 Exit 2 SB On Loop Ramp (over Pelham Road, NH 97)
- Brookdale Road (over I-93 NB & SB)
- I-93 NB & SB (over NH 111A)
- I-93 NB & SB (over NH 111)
- I-93 Exit 3 NB & SB Loop Ramp (over NH 111)
- I-93 NB & SB (over North Lowell Road)
- I-93 NB & SB (over Fordway Extension)
- I-93 NB & SB (over Kendall Pond Road)
- I-93 NB & SB (over Beaver Brook)
- NH 102 (over I-93 NB & SB)
- Ash Street (over I-93 NB & SB)
- I-93 NB & SB (over Stonehenge Road)

- I-93 NB & SB (over NH 28)
- I-93 NB & SB (over Railroad Corridor)
- I-93 NB (over Cohas Brook Sta. 1917+00)
- I-93 NB (over Cohas Brook Sta. 1965+00)
- I-93 NB & SB (over Bodwell Road)
- I-93 / I-293 NB (over Cohas Brook Sta. 1989+00)

Ledge removal also represents a source of higher noise levels due to blasting and other activities. Major ledge removal is anticipated for the following locations:

- I-93 NB & SB (500-foot section south of Exit 3 Interchange)
- I-93 NB & SB (2,500-foot section within Exit 3 Interchange)
- I-93 NB & SB (1,000-foot section north of Exit 3 Interchange)
- I-93 NB & SB (1,500-foot section south of North Lowell Road)
- I-93 NB & SB (1,500-foot section north of North Lowell Road)
- I-93 NB & SB (2,500-foot section north of Windham/Derry Townline)
- I-93 NB & SB (1,000-foot section within Exit 4 Interchange)
- I-93 NB & SB (1,600-foot section north of Pillsbury Road/Ash Street)
- I-93 NB & SB (3,500-foot section north of Stonehenge Road)
- I-93 NB & SB (1,500-foot section at the Londonderry/Manchester Townline)
- I-93 NB & SB (1,500-foot section south of Bodwell Road)

**Table 4.8-3**
**Construction Equipment Noise Emissions**

| Equipment Type | Noise Levels (dBA @50FT) |
|---|---|
| **Earthmoving** | |
| Front Loader | 84 |
| Backhoe | 84 |
| Bulldozer | 88 |
| Tractor | 84 |
| Scraper | 90 |
| Grader | 83 |
| Truck | 90 |
| Paver | 84 |
| Vibrator | 76 |
| **Materials Handling** | |
| Concrete Mixer | 83 |
| Crane | 82 |
| Derrick | 88 |
| **Stationary** | |
| Pump | 71 |
| Generator | 81 |
| Compressor | 89 |
| **Impact Devices** | |
| Pile Driver | 91 |
| Pavement Breaker | 89 |
| Pneumatic Tool | 80 |

Source: "Highway Construction Noise: Environmental Assessment and Abatement, Volume IV: User's Manual". Vanderbilt University, Nashville, TN. Report No. VTR-81-3, 1981.

## 4.8.6 Summary

The receptor locations that are approximately located within 500 feet of the existing I-93 travel way currently experience sound levels that approach, are at, or exceed the FHWA's Noise Abatement Criteria (NAC). The I-93 Build Alternatives will result in capacity and alignment improvements that will result in relatively slight, up to 5 dBA, increases in sound levels to these receptor locations.

The noise analysis evaluated 35 receptor locations that included over 1,200 residential and commercial buildings. Future 2020 Build Alternative sound levels are expected to exceed the NAC along the I-93 corridor. Receptor locations 11B, 13A, 13B, 13 Center A, 13 Center B, 14 East, and 26 (as depicted in **Figures 3.8-1 to 3.8-23)** are expected to experience sound levels below the threshold level of the NAC. Noise mitigation measures were evaluated for all the receptor locations that were found to approach, be at, or exceed the NAC under the 2020 Build Alternative to determine if noise levels could be reduced. Noise barriers were evaluated as the primary mitigation measure. The FHWA's and the NHDOT's noise abatement criteria and guidelines were used to evaluate each receptor location. Mitigation measures were found to be reasonable and feasible for 12 receptor locations (Receptor locations 1, 4, 6, 7, 8, 9, 11A, 19, 23, 24, 27, and 28) based upon acoustical, engineering, and economic considerations. Noise barriers for the remaining 16 receptor locations were found to not meet the cost-effective criteria because there were not enough impacted residences that could achieve an adequate noise reduction. In addition, 4 receptor locations (Receptor locations 12, 18, 20, and 25), which had sound levels that exceeded the NAC, but did not meet the noise barrier criteria, were determined eligible to receive a privacy fence. A detailed discussion of the noise barrier evaluation is presented in Appendix F.

### 4.8.7 Future Noise Levels for Planning Purposes

The noise analysis has developed data that may be useful to local officials in their planning efforts for future development along the existing I-93 corridor. In order to limit the creation of new noise impacts based upon the FHWA Noise Abatement Criteria (i.e., less than 66 dBA for residential development and 71 dBA for commercial development) in the year 2020, the following is suggested for the local officials' consideration:

- Along existing I-93 corridor, residential development would ideally be no closer than the 66 dBA noise contour as presented in **Figures 3.8-1 to 3.8-23**.
- New development should include a buffer area for potential future noise abatement.

## 4.9 Visual Impacts

### 4.9.1 Build Alternatives

Probable visual effects on the resources outlined in Chapter 3 were considered and are reported by alternative below.

In general, widening the highway would increase the overall roadway footprint and create larger cut and fill slopes, which will increase the visual scale of the roadway. The larger footprint will also necessitate removal of some existing roadside vegetation. Where this vegetation is part of forested buffer between the highway and adjacent development, this would have an adverse effect upon the quality of views from the highway.

Removal or reduction of the vegetative buffers between the highway and development would have a more substantial adverse effect on nearby residences and businesses than on highway users. In addition, removal of forested areas and/or ledge within the median will change the visual environment for highway users from a rural/forested setting to a more built environment by eliminating portions of the visual buffer between the northbound and southbound barrels.

The discussion below highlights potential impacts to the visually sensitive resources for each highway segment identified in Section 3.9, including areas where vegetative buffers provide screening of the highway from residential areas adjacent to the project.

## Three-Lane Alternatives

### Segment A

The widened highway will encroach on the Haigh Avenue residential area in Salem on the easterly side of I-93 south of the Rest Area, resulting in the removal of existing forested buffer. In this location, a sound wall will be erected which will screen the residential area from the highway. A small vegetated buffer will remain between the residences and the sound wall.

### Segment B

No adverse impacts will result to the Brady Avenue scenic corridor, since the visually sensitive portion of the corridor is not located in the immediate vicinity of I-93.

Two residential areas located to the east of Exit 1 may be affected by the reconstruction of the northbound off-ramp, which may remove a portion of the existing vegetative buffer between the highway and several homes on McGregor Road and McLarnon Road. In this area, construction of a sound wall is planned that will shield the residences from the highway. Both the Three-Lane and Four-Lane Alternatives have similar impacts in this location.

### Segment C

The highway upgrade will remove forested buffer between the highway and adjacent residences on Trolley Lane north of NH 38 in Salem. Construction of the Three-Lane Alternative is expected to remove enough vegetative buffer such that the highway will become visible to approximately four homes in this area, which would have a moderate adverse effect on these properties.

The mobile home park on Fern Road south of NH 38 on the west side of I-93 would also lose a portion of the vegetative screening. A sound wall will be constructed which would shield residences from the highway. Additionally, reconstruction of the highway in the Exit 2 area will result in the removal of portions of the existing forested buffer and ledge outcrops between the northbound and southbound barrels. Under the Three-Lane Alternative in the vicinity of Exit 2, highway users will have views of the opposite barrel where the forest and ledge in the median now provide a buffer and creates a relatively rural, forested visual setting. The highway widening will change the visual environment in this vicinity to a more open, built environment with views of the opposite highway barrels. Both the Loop and Diamond Interchange Options for Exit 2 will have this effect.

### Segment D

The widening in Segment D involves either shifting approximately 0.8 miles of the northbound barrel of the highway into the existing highway median in the immediate vicinity of Exit 3 (i.e., the Northbound Shift) or shifting both barrels of the highway along approximately 1.9 miles of highway (i.e., the Tight-Shift Option). Additionally, the Preferred Alternative or Tight Shift Option would reduce the steep grade of the southbound barrel near Exit 3 to improve traffic operations and safety.

Both the Northbound-Shift Option and the Tight-Shift Option will reduce the overall footprint of the Exit 3 Interchange, but will result in the removal of substantial areas of forest and ledge. The Tight-Shift Option in particular will result in substantial forest clearing and ledge cuts for approximately 1.5 miles south of Exit 3.

Despite the relatively substantial change to the visual environment in this Segment, only a few viewers of the highway are likely to be directly impacted. Specifically, two residential areas to the west of the current I-93 alignment in Segment D consisting of fewer than 12 homes are likely to see the change in the visual character of the area. These neighborhoods are located on NH 111A/Lower Locust Road and Squire Armor Road in Windham. These properties are located within 100 to 500 feet of I-93 at an elevation that allows views of the highway. The homes are partially shielded from the highway by a vegetative buffer that will remain largely intact. But the change in the visual scale of the highway represents a moderate adverse impact for the Northbound Shift Alternative, and a moderate to high adverse impact for the Tight-Shift Alternative. Additionally, the Build Alternatives all propose to increase the height of the bridge carrying I-93 over NH 111A. In the case of a few residences on NH 111A, the higher bridge structure will further increase the visual scale of the adjacent highway.

The changes at Exit 3 will also change the visual character of the highway for motorists. The larger, straighter highway will create a more homogeneous visual setting than is now present.

Options in Segment D also include a relocation of approximately 0.9 miles of NH 111. The relocated NH 111 will cross an intact forested area of relatively high visual character north of existing NH 111. Portions of the relocated section will be visible to motorists on I-93, adjacent to commercial properties, and to some degree residences fronting along existing NH 111 in the area. Approximately one-third of the relocated NH 111 will be located in a cut and will be fully or somewhat visually shielded from the residences adjacent to Cobbetts Pond to the south (e.g., on Rocky Ridge Road).

No change will occur to the visual setting of Searles Castle, a locally important cultural feature located on a hillside approximately 2000 feet to the northeast of Exit 3. The Castle property does not currently have a view of the highway, and even with the change in the vicinity of Exit 3 a substantial vegetative buffer will continue to shield the Castle.

### Segment E

The project will have no impact on the open space and recreational areas identified in the Derry Master Plan (Table 3.9-1), since these areas are not located adjacent to the highway and have no views to or from the highway.

Four neighborhoods in Segment E are located in close proximity to the existing highway and may be affected by removal of the existing vegetative buffer between residences and the highway corridor. Construction of the Three-Lane Alternative will have a low adverse impact on Fordway Extension and Derryfield Road in Derry and Charleston Avenue (impacted by the westerly widening option only) and Trolley Car Lane in Londonderry. A privacy fence or a sound wall is planned for each of these areas, which should mitigate adverse visual impacts for the homeowners to some degree.

Moderate adverse impacts are expected to users of the Woodmont Orchard in Londonderry since all alternatives will impact the existing wooded buffer between the orchard and the highway. The Westerly Option in Segment E would remove almost the entire 100-foot buffer, while an Easterly Widening would allow some wooded buffer to remain between the roadway and the orchard. The Easterly Widening would minimize the effect of the project upon users of the orchard, which is considered open space in the community.

### Segment F

The majority of the highway corridor in Segment F is forested, which provides screening of the adjacent highway barrel and creates a rural/undeveloped visual setting. The portion of the highway from Stonehenge Road to Exit 5 (NH 28) will be affected by removal of the forested buffer currently present in the median. No adverse effect will result north of Exit 5 since only a slight amount of vegetation clearing in the median or along the sides of the corridor will result from the Build Alternatives.

There are no residential areas within Segment F where the highway project will affect visual buffers.

### Four-Lane Alternative

Impacts associated with the Four-Lane Alternative are essentially identical to the Three-Lane Alternative. The Four-Lane Alternative adds an additional 12 feet of highway width for both the north and southbound barrels, resulting in a slight increase of the visual scale of the Four-Lane widening of the highway relative to the Three-Lane Alternative. The Four-Lane Alternative would result in a moderate adverse effect on the residences and businesses in close proximity to the reconstructed or relocated highway at the locations discussed in the Three-Lane Alternative above.

### Four-Lane/Three-Lane Combination Alternative

This alternative would result in the same visual impacts as the Four–Lane Alternative through Exit 3. North of Exit 3, the visual impacts are the same as the Three-Lane visual impacts. The additional lane south of Exit 3 would necessitate a small amount of additional clearing in forested areas along the highway to accommodate the extra width. This clearing will remove some additional screening between the highway and any adjacent residential or commercial areas.

### Bike Path

The addition of a bike path will only require a small increase in widening of the footprint between Exit 2 and Exit 5 on the side of the highway where it is located. With appropriate landscaping no appreciable increase in visual impacts is expected.

### Park and Ride Facilities

The proposed park and ride lots at Exits 2, 3 and 5 will vary in size from 8 to 12 acres. In most cases, additional removal of natural vegetation will be necessary and will result in some reduction in the visual screening between the lots and any nearby residences (*e.g.*, along South Policy Road at the proposed Exit 2 facility, along West Shore Drive at Exit 3).

■

## 4.92 No-Build Alternative

The No-Build Alternative would not directly alter the visual environment.

### 4.9.3 Mitigation

Mitigation treatments will be developed at the final design stage. These measures will include:

- Landscape planting and natural revegetation of the cut and fill slopes.
- Structural design considerations for drainage structures, bridges, guardrail, etc., to enhance their visual appearance.
- Highway lighting, including park and ride facilities, will be designed with "cut offs" or similar features to limit light pollution.
- Since areas that are visually impacted are also often impacted by noise, sound walls will serve a dual purpose by mitigating for both noise and visual impacts. In general, landscaping amenities are often constructed in conjunction with the sound walls where practical.
- Privacy fencing in four locations (at NH 111A in Windham, Fordway Extension in Derry, Charleston Avenue in Londonderry and Rockingham Road in Londonderry) will also help shield adjacent residential properties from the visual impacts of the highway.

## 4.10 Cultural Resources Impacts

### 4.10.1 Archaeological Resources

#### 4.10.1.1 Impact Method

The National Environmental Policy Act requires that federal agencies assess the effects of a proposed project on archaeological resources that are identified in the Phase II level of investigation as eligible for the National Register of Historic Places. It further directs the agency to consider how project alternatives reduce the impact of those effects on archaeological properties by in-place preservation where possible (See Section 3.10.3.3 for a description of archaeological phases.)

The potential effects of each alternative on identified archaeological resources and archaeologically sensitive areas were determined by overlaying each corridor's alignment on the original archaeological resources constraints map (**Figure 3.10-1** and Table 4.10-1). The map scale used for this analysis was 1:800. Resources identified on the constraints map were examined at several levels of investigation as shown in Tables 3.10-1 through 3.10-4. They include: Phase IB subsurface testing of sites in the median with a preliminary identification of boundaries (Table 3.10-1), supplemental Phase IA subsurface testing of sites along the shoulders without boundary identification (Table 3.10-2), supplemental Phase IA subsurface testing of sensitivity areas along the shoulders that as yet failed to produce archaeological deposits but require additional testing (Table 3.10-3), and aboveground historical architectural remains in both the shoulders and median of the I-93 corridor identified at a Phase IA level (Table 3.10-4). However, it should be noted that subsurface testing at four historical archaeological sites including 27 HB 19 and 27 HB 7-9 in Table 3.10.1 were only examined at the Phase IA level. Because the extent of most of the sites has yet to be identified, impact is defined judgmentally as present or absent. Impacts were analyzed for all segments.

Because the Three- and Four-Lane Alternatives as well as the Four-Lane/Three-Lane Combination Alternative have similar impacts on archaeological sites at the current level of information, the differences in the effects of the two alternatives are analyzed at the Four-Lane level only. Typically, site boundaries are not identified until Phase II. The distinctions made in the analysis among each set of options for each segment are indicated under each section.

Impacts to archaeological sites are summarized in **Figure 4.10-1** and are described in the next section.

### 4.10.1.2 Build Alternatives

#### Segment A

Only one option for Segment A, the linear area between the Massachusetts border and Cross Street, is considered. Archaeological investigations did not locate identified archaeological sites or sensitivity areas within Segment A.

#### Segment B

Segment B that includes Exit 1 was analyzed for both the Option 1 reconstruction and Option 2 relocation. Reconstruction of the corridor in this segment will not impact any identified archaeological sites or sensitivity areas. Option 2, the relocation of Segment B, will impact two identified archaeological sensitivity areas, NA 2-10-7 and NA 2-10-8 (Table 3.10-3). Limited archaeological testing was performed in these two areas as supplemental Phase IA investigations. Although archaeological deposits have not been identified in either, some additional testing will be required to achieve the NHDHR standard of 8-meter testing interval.

### Segment C

Segment C that includes Exit 2 was analyzed for both the loop and diamond options. Nine of the identified archaeological sites and sensitivity areas are impacted by both options. They impact three identified sites, 27 RK 327, 27 RK 329, and 27 RK 330 (Table 3.10-2) that have undergone supplemental Phase IA investigations. The two options also impact three sensitivity areas, NA 2-15-13, NA 3-18-14, and NA 3-24-20 (Table 3.10-3). Limited archaeological testing was performed in these three areas as supplemental Phase IA investigations. Archaeological testing identified a single historic artifact in one of the three areas. Some additional testing will be required to achieve the 8-meter testing interval. Finally, three historic remains would be affected by the two options, H 2-13/15-5, H 2-13-6, and H 2-14-7 (Table 3.10-4). Some additional investigations are necessary for each of these resources as noted in Table 4.10-1. Option 1, the loop option, also impacts Site 27 RK 328 (Table 3.10-2). Tested at a supplemental Phase IA, this site will require further investigation to enable evaluation of significance.

### Segment D

Segment D that includes Exit 3 was analyzed for all nine options. All nine options impact fourteen of the archaeological sites or sensitivity areas. Three archaeological sites and one sensitivity area are affected by three or more of the options. Identified Sites 27 RK 8, 27 RK 9, 27 RK 7, 27 RK 316, and 27 RK 335 (Table 3.10.1-2) and Sensitivity Areas NA 3-24-20, H 3-30-24, H 4-47-33, H 3-28/29-13, H 3-32-21, H4-35/36-26, H 4-38/40/47-28, H 4-38-29, and H 4/48/50-33 are impacted by all of the options. These sites have been examined at Phase IA, IA supplemental, or IB levels of investigation. Their extent, any associated features, and significance still require determination through the Phase II level of testing.

Additionally, seven sites and sensitivity areas are impacted by the following options. The I-93 northbound shift, Options 1 through 6, impact Sites 27 Rk 330, 27 Rk 331, and 27 Rk 332. Identified Site 27 RK 343 (Table 3.10-2) may be impacted by Options 1, 2, and 7. These options include the on-line improvement of Route 111. Depending on the extent of the proposed shoulders, Site 27 RK 343, a marker, and its associated landscape, may be avoided through design modifications. Sensitivity Area H 4-38-27 (Table 3.10-4) is not impacted by Options 1 and 2, the on-line, I-93 Northbound Shift. Site 27 RK 343 and sensitivity area H 4-38-27 have only been identified by surface reconnaissance at the Phase IA level and will need further evaluation at the Phase IB and II levels to determine associated features, extent, and significance.

### Segment E

Segment E that includes Exit 4 was analyzed for both Options 1 and 2, the east and west shifts. Both the options impact nine sensitivity areas and Option 2, the west option, affects two additional sensitivity areas. Sensitivity Areas NA 4-54-40, NA 4-57-41, NA 4-59-45, NA 5-71-49, and NA 5-71-50 (Table 3.10-3) and Sensitivity Areas H 4/55/56-36, H 5-67/69-40, H 5-67-42, and H 5-70/74-45 (Table 3.10-4) are impacted by both options. Option 2 also affects sensitivity areas NA 4-62-46 and NA 5-67-47 (Table 3.10-3). All these sensitivity areas have been identified only at the Phase IA level. Their extent, any associated features, and significance still require determination at the Phase IB and II levels of investigation.

### Segment F

Segment F that includes Exit 5 was analyzed for all options including Options 1, 2, and 3. These options incorporate the relocation of NH 28, the reconstruction of NH 28, and the relocation of the northbound ramps. All three options impact 17 areas: eight identified sites and nine sensitivity areas. The identified archaeological sites include 27 HB 17, 27 HB 216, 27 HB 20, 27 HB 15 (Table 3.10-1), 27 HB 218, 27 HB 221, 27 HB 219, and 27 HB 26 (Table 3.10-2). All three options also affect the following sensitivity areas: NA 6-79-56, NA 6-79-57, NA 6-92-82, H 6-92-83 (Table 3.10-3), H 5-70/74-45, H 5-77/79-47, H 6-79-48, H 6-82-49, and H 6-93/94-51 (Table 3.10-4). The archaeological sites have been identified at the Phase IB and supplemental Phase IA levels respectively. The sensitivity areas have been identified only at the Phase IA level. Site extent, any associated features, and significance still require determination through the Phase IB and II levels of testing as appropriate.

### Bike Path

The bike path impacts the following archaeological sites: H 4-42-30, H 4-43-31, H 4-38/40/47-28, H 4-52/54-35, H 4-55/56-36, NA 4-57-41, NA 4-54-40, NA 5-71-49, NA 5-71-50, H 5-67-41, and H 5-67-42.

### Sound Walls

Because the sound walls are located in the proposed right-of-way, impacts to archaeological sites are shown as part of the Build Alternative discussion (Table 4-10-1). For additional discussion on sound walls, see Section 4.8.4 and Table 4.8-2.

### Park and Ride Lots

There are no impacts for any of the I-93 NB Shift Options (Options 1-6). The Park and Ride Lot at Exit 2 impacts site H 2-14-7, and the Park and Ride Lot at Exit 3 affects site H 3-32-21. Archaeological sites are not impacted by any of the Exit 5 Park and Ride Lot options.

## 4.10.1.3 No Build

The No-Build Alternative will not affect identified archaeological sites or sensitivity areas since new construction would not occur.

### 4.10.1.4 Summary

**Figure 4.10-1** illustrates in a matrix format the number of identified archaeological sites and sensitivity areas impacted by each option. Because boundaries of each site have not in most cases been determined, the acreage impacted by each option cannot be computed at this stage. This matrix also indicates the number of options that impact each site.

#### Recommendations for Further Investigations and Potential Mitigation

Recommendations for the next phase of site investigation are provided in Tables 3.10-1 through 3.10-4. The NHDHR and FHWA have reviewed these recommendations for future studies. Typically, archaeological sites are identified at the Phase IA and in some cases at supplemental Phase IA or Phase IB levels during the development of the draft environmental study. A supplemental Phase IA or Phase IB level of study, as shown in Tables 3.10-1 and 3.10-2, have identified potential site locations and indicated whether archaeological resources are present. Phase II investigations would provide clear site boundaries and indicate which sites are significant for the National Register of Historic Places.

Sensitivity areas listed in Table 3.10-3 have undergone initial testing at a 10-meter interval. This effort has resulted in the location of no or very minimal archaeological deposits. The sensitivity areas along the chosen corridor will require further testing at the full Phase IB level to create an 8-meter testing interval, ensuring the absence of significant deposits. Such testing would occur between the Draft (DEIS) and Final (FEIS) Environmental Impact Statement. This interval will ensure that the small Native American archaeological sites common to New Hampshire do not exist within these sensitivity areas. Finally, those sensitivity areas listed in Table 3.10-4 represent aboveground remains of buildings such as farmsteads and gristmills, boundary walls and stonewall enclosures, bridge abutments and dams, quarry sites, stone dumps, and the corridor of roads, railroads, and trolley beds that were identified at the Phase IA level. No subsurface archaeological investigations have occurred to determine associated deposits or their underground extent. Limited historical research has, in some cases, been able to provide some identification of ownership and function. Phase IB and II investigations including subsurface testing and additional historical research would be needed to identify associated deposits, determine their underground extent, provide associations and functions, and complete the determination of site significance.

The Determination of Effects (DOE) process and the Section 4(f) analysis cannot be completed prior to the completion of the DEIS because the site boundaries have not been identified. Because of the time-consuming nature of archaeological investigations, Phases IB and II are not usually completed for all the alternatives identified in the DEIS. Between the DEIS and the FEIS, site examination is completed at least through the Phase IB or II level of study for the preferred corridor to provide horizontal and vertical site extent into the proposed project area and more clearly identify the age, cultural associations, site function, the existence of features, and enhance the data sample. This information provides the area of each site within the corridor boundaries, enabling the completion of the Section 4(f) analysis for the FEIS. However, it is unlikely that archaeological sites will be determined to be eligible for protection under Section 4(f). It also provides data from which to estimate initial significance evaluation completed at the Phase II level.

Once the additional studies are completed to the Phase II level for those sites along the preferred alignment, as shown in Tables 3.10-1 through 3.10-4, the level of effect to those sites found to be eligible for the National Register can be determined. Some sites may require mitigation, depending on the level of effect by the project. At least three approaches to the mitigation of these archaeological resources are possible.

A decision of the importance of preservation in-place versus data recovery will need to be made. If preservation in-place is necessary, then a change in design or location will be made, where feasible and prudent, to satisfy Section 4(f). In some cases, the location of the corridor may be moved slightly or work adjacent to the site may be modified so that the site will not be impacted by the preferred alternative. Preservation-in-place preserves the site for future archaeological study when it may address future research needs that may not have as yet been identified. If preservation-in-place is not required and data recovery becomes the appropriate form of mitigation, then Section 4(f) does not apply to the resource. The second form of mitigation involves the recovery of the information that the site may yield under National Register Criterion D by implementing a data recovery plan. In a few cases, previously identified archaeological sites in the vicinity of, but not impacted by, the alignment and of a similar age, type, function, and composition may provide similar or superior data to address research questions identified for the significant site impacted by the preferred corridor. In this instance, the previously identified site may be excavated using a data recovery program. While this form of mitigation needs to be completed prior to the completion of the project, its excavation can continue while work commences within the corridor. Whether archaeological information is gained through the excavation of the site within the corridor or an alternative site, information would be distributed to the public through such venues as site reports, public lectures, school programs, interpretive brochures, and, depending on the nature of the site, public visitation during investigations.

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## 4.10.2 Historic Resources

### 4.10.2.1 Methods To Determine and Evaluate Impacts

At a meeting of NHDHR, FHWA, NHDOT and the consultant team held on March 14, 2002, impact evaluations were made for historic properties that had been determined eligible for the National Register of Historic Places. Consensus determinations were made in all cases. NHDHR/FHWA Determinations of Eligibility/Effect (36 CFR 800) forms are included in Appendix G. An Effect Memo was signed August 8, 2002.

Criteria of Effect and Adverse Effect were determined based on the Section 106 review process established by the National Historic Preservation Act of 1966 and outlined in 36 CFR 800.9, which defines the following:

**No Effect:** The undertaking will not affect any historic property.

**Effect:** The undertaking may alter National Register-qualifying characteristics and features of location, setting or use.

**Adverse Effect:** The undertaking may diminish the integrity of design, setting, materials, workmanship, feeling or association. Adverse effects include, but are not limited to:

- Physical destruction, damage, or alteration of all/part of the property,
- Isolation from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register,
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting,
- Neglect of a property resulting in its deterioration or destruction, or
- Transfer, lease, or sale of the property.

Otherwise adverse effects may be considered not adverse in the following circumstances:

- When the property is of value only for potential contribution to research, and when such value can be substantially preserved through appropriate research in accordance with professional standards and guidelines,
- When the undertaking is limited to rehabilitation of buildings and structures and is conducted in a manner that preserves the historical and architectural value of affected historic property through conforming with the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings, or
- When the undertaking is limited to transfer, lease, or sale of a historic property, and adequate restrictions or conditions are included to ensure preservation of the property's significant historic features.

**No Adverse Effect:** The undertaking may affect one or more historic properties, but the effect will not be harmful to the National Register qualifying aspects of the property.

### 4.10.2.2 Build Alternatives

A description of the impacts on individual historic properties is given below. A summary of the impacts on historic resources is provided in a matrix format in **Figures 4.10-2 and 4.10-3** for the Three-Lane and Four-Lane Alternatives, respectively.

#### Three-Lane Alternative

#### Segment A

There are no Section 106 impacts in Segment A. The Three-Lane and Four-Lane Alternatives are exactly the same in this segment and create a 4(f) impact on the Kinzler House (SAL0204), located on Cross Street. Some 2,200 square feet will be acquired for right-of-way and 1,200 square feet for slope work. However, these actions would constitute a no adverse effect on the National Register-eligible characteristics of the property.

#### Segment B

There are no impacts in Segment B.

#### Segment C

There are no impacts in Segment C.

#### Segment D

Options 1, 2 and 7 in Segment D create a 4(f) impact on the George Dinsmore House (WND0033) through slope work that would affect 1,500 square feet of the 1.1-acre eligible parcel.[37] However, the undertaking would not alter any of the National Register-eligible characteristics of the property, thus no Section 106 effect will occur.

Options 7 through 9 in Segment D will involve an adverse effect under Section 106 and a 4(f) impact to two historic properties: the Robert Armstrong House (WND0086) and the George Armstrong House (WND0085), both located on NH 111A (Range Road) in Windham. The historic structures on these properties will need to be relocated or demolished.

[37] Since the actual extent of slope work on this property will only be known after final design, a permanent easement was assumed as the worst-case scenario for the prediction of impacts.

### Segment E

Three impacts to historic properties will occur in Segment E. The widening of the northbound and southbound lanes of I-93 will necessitate the replacement of the Robert J. Prowse Bridge (LON0116), which is eligible for the National Register. This constitutes an adverse effect through physical destruction of the historic structure under Section 106. This would also involve a Section 4(f) impact.

The Woodmont Orchards Historic District (LON-D1) will be impacted under the Westerly Option by right-of-way acquisition of slightly less than 5.4 acres along the west side of I-93 in Segment E and slope impacts to a little less than 3.6 acres in the same area. These impacts will alter integrity of location, setting, and use and may diminish integrity of design, setting, materials, workmanship, feeling, and association within the district, resulting in both a Section 106 adverse effect and a 4(f) impact. There are no impacts to this property with the Easterly Option.

The Reed Paige Clark Homestead (LON0114) on Stonehenge Road will be impacted by the loss of approximately 2 acres of land along its eastern boundary with I-93 due to right-of-way acquisition, of which 0.2 acres of land will be affected by slope work. The impacts would not create an adverse effect under Section 106, because the work will not affect any National Register eligible characteristics of the property. This area has been previously disturbed by construction and was not traditionally part of the agricultural operations because of its topography. However, acquisition of 2 acres from the site constitutes a Section 4(f) impact.

### Segment F

The Gearty House (LON0105) on Stonehenge Road will be affected by right-of-way acquisition of 100 square feet and slope work on 365 square feet of the property along its frontage. The work would result in a Section 4(f) impact and constitutes a Section 106 adverse effect.

## Four-Lane Alternative

### Segment A

There are no Section 106 impacts in Segment A. The Three-Lane and Four-Lane Alternatives are exactly the same in this segment and create a Section 4(f) impact on the Kinzler House (SAL0204), located on Cross Street. Some 2,200 square feet will be acquired for right-of-way and 1200 feet for slope work. However, these actions would constitute a no adverse effect on the National Register-eligible characteristics of the property.

### Segment B

There are no impacts to historic properties in this segment.

### Segment C

There are no impacts to historic properties in this segment.

### Segment D

Options 1, 2 and 7 in Segment D would create a Section 4(f) impact on the George Dinsmore House (WND0033) through slope work that would affect 1,500 square feet of the 1.1-acre eligible parcel. However, the undertaking would not alter any of the National Register-eligible characteristics of the property, thus no adverse effect relative to Section 106 would occur.

Options 7 through 9 in Segment D will involve an adverse Section 106 effect and a Section 4(f) impact to two historic properties: the Robert Armstrong House (WND0086) and the George Armstrong House (WND0085), both located on NH 111A (Range Road) in Windham. The historic structures on these properties will need to be relocated or demolished.

### Segment E

Three impacts to historic properties will occur in Segment E. The widening of the northbound and southbound lanes of I-93 will necessitate the replacement of the Robert J. Prowse Bridge (LON0116), which is eligible for the National Register. This constitutes an adverse effect through physical destruction of the historic structure under Section 106 and would also involve a Section 4(f) impact.

The Woodmont Orchards Historic District (LON-D1) will be impacted by right-of-way acquisition of 5.4 acres along the west side of I-93 in Segment E and slope impacts to 3.6 acres in the same area for the Westerly Option. These impacts will alter integrity of location, setting, and use and may diminish integrity of design, setting, materials, workmanship, feeling, and association within the district, resulting in both a Section 106 adverse effect and a Section 4(f) impact. There are no impacts to this property with the Easterly Option.

The 114.4-acre Reed Paige Clark Homestead (LON0114) on Stonehenge Road will be impacted by the loss of approximately 2 acres of land along its boundary with I-93 due to right-of-way acquisition, of which 0.4 acres of land will be affected by slope work. The impacts would not create an adverse effect under Section 106, because the work will not affect any National-Register eligible characteristics of the property. This area has been previously disturbed by construction and was not traditionally part of the agricultural operations because of its topography. However, acquisition of 2 acres from the site constitutes a Section 4(f) impact.

### Segment F

The Gearty House (LON0105), which contains 1.5-acres, will be affected by right-of-way acquisition of 1,000 square feet and slope work on 2,600 square feet of the property along its frontage. This will result in a Section 4(f) impact, and constitutes an adverse Section 106 effect.

### Four-Lane/Three-Lane Combination

Under the Combination Alternative in Segments A through C, only one historic resource (Kinzler House, SAL0204) will have a Section 4(f) impact, but there will be no adverse effect under Section 106 since the National Register-eligible characteristics will not be altered. Impacts in Segments D through F are the same as described above for the Four-Lane Alternative.

### Bike Path

No additional historic resources will be impacted by construction of the bike path.

### Sound Wall

Since the sound walls are being erected within the highway right-of-way (either existing or proposed), the impacts on eligible historic properties have already been taken into account in the above descriptions for the Build Alternatives.

## 4.10.2.3 No-Build Alternative

The No-Build Alternative has no direct effect on historic resources.

## 4.10.2.4 Mitigation

If a project cannot be designed to avoid historic properties, then appropriate mitigation to reduce impacts will be provided. This mitigation can include documenting the adversely affected properties using HABS (Historic American Buildings Survey) or HAER (Historic American Engineering Record) standards; minimizing land acquisition and maximizing the distance between the highway corridor and the historic structure; providing access as necessary to maintain existing land uses; and providing landscaping and screening where appropriate to minimize visual and noise impacts.

The following properties are being mitigated because of Section 106 and 4(f) impacts. Mitigation measures for this project are listed below on a property-by-property basis, with applicable alternatives identified. (Properties which do not have Section 106 adverse effects may have Section 4(f) impacts. See Chapter 5 for a discussion of Section 4(f) impacts.)

#### The George F. Armstrong House (WND0085)

The only possible mitigation for the loss of this property under Options 7 through 9 of the Three- and Four-Lane Alternatives is to record the buildings to HABS standards. It will then be marketed with a protective covenant for relocation to an appropriate setting. A portion of demolition costs may be allocated as an incentive for relocation.

#### Robert Armstrong House (WND0086)

The only possible mitigation for the loss of this property under Options 7 through 9 of the Three- and Four-Lane Alternatives is to record the house to HABS standards, then market it with a protective covenant for relocation to an appropriate setting. Because of the high architectural quality and integrity of the house, the feasibility of NHDOT relocating it to a suitable setting and providing foundation, water and sewer to facilitate marketing with a protective covenant will be considered.

#### Woodmont Orchards Historic District (LON-D1)

There is no effective mitigation for the adverse effect of slope work under the Three-Lane and Four-Lane Westerly Options. The Three-Lane and Four-Lane Easterly Options would avoid this impact.

#### Robert J. Prowse Memorial Bridge (LON0116)

The mitigation for the loss of this structure under both alternatives would be to record the bridge to HAER (Historic American Engineering Record) standards and market it for relocation. The original bridge plaque would be retained and a commemorative marker installed between the new bridge and the bike path. An enlarged, captioned photograph of the bridge will be placed in the NHDOT lobby.

#### Gearty House (LON0105)

The mitigation for adverse impacts to this property caused by the right-of-way acquisition and slope work under all alternatives includes minimizing acquisition and slope work, which limits impacts to the property.

# 4.11 Socio-Economic Impacts

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## 4.11.1 Primary Impacts

### 4.11.1.1 Methodology

An assessment of the socio-economic impacts was performed for each alternative and option utilizing engineering drawings and maps of the study area at a scale of one inch equals 200 feet and through field surveys of the study area. The residential and commercial structures that would be acquired to construct any of the three full-Build Alternatives were determined. In most cases, the need to acquire the structure is due to its location within the proposed right-of-way, and in some cases, it is due to the loss of access. Structures were grouped into two categories: residential and business. Residential included all forms of housing, both single and multifamily, and business included all non-residential uses.

In general, the people in the households that may potentially be displaced appear to have the same social and economic characteristics as the rest of the residents in their towns of residency. The race, or ethnicity, of the potentially displaced persons also appears to be similar to the rest of the residents in their towns. Prior to the acquisition stage, special arrangements will be made to deal with the needs of the disabled or elderly people identified.

#### 4.11.1.2 Property Purchase

There will be property purchased in connection with the alternatives and options being considered for planned improvements to I-93. Purchases involving the full acquisition of buildings and the relocation of homeowners or businesses are addressed in this section. The following Table 4.11-1 lists the required residential and business total property acquisitions related to the alternatives and options being considered for planned improvements to I-93. For more detailed information relative to these residential and business acquisitions, refer to Appendix H, NHDOT Conceptual Relocation Plan.

**Table 4.11-1**
**Residential and Business Total Property Acquisitions**

| Road Segment | Option | Three-Lane Alternative | | Four-Lane Alternative | |
|---|---|---|---|---|---|
| | | Number of Residential Acquisitions | Number of Business Acquisitions | Number of Residential Acquisition | Number of Business Acquisitions |
| A | South of Cross Street | 1 | 0 | 1 | 0 |
| B | Reconstruct | 3 | 0 | 3 | 0 |
| B | Relocate | 4 | 0 | 4 | 0 |
| C | Loop | 4 | 1 | 4 | 1 |
| C | Diamond | 3 | 1 | 3 | 1 |
| C | Exit 2 Park & Ride (East of NB lanes) | 7 | 1 | 7 | 1 |
| D | NB Shift (Option 1) | 0 | 5 | 0 | 5 |
| D | NB Shift (Option 2) | 0 | 5 | 0 | 5 |
| D | NB Shift (Option 3) | 1 | 7 | 1 | 7 |
| D | NB Shift (Option 4) | 1 | 7 | 1 | 7 |
| D | NB Shift (Option 5) | 1 | 8 | 1 | 8 |
| D | NB Shift (Option 6) | 1 | 8 | 1 | 8 |
| D | NB/SB Tight Shift (Option 7) | 1 | 6 | 1 | 6 |
| D | NB/SB Tight Shift (Option 8) | 2 | 8 | 2 | 8 |
| D | NB/SB Tight Shift (Option 9) | 2 | 9 | 2 | 9 |
| D | Exit 3 Park & Ride (Between SB & NB lanes, or East of NB lanes)[1] | 1 | 0 | 1 | 0 |
| E | East | 3 | 2 | 3 | 2 |
| E | West | 3 | 2 | 3 | 2 |
| F | Relocate NH 28 | 0 | 1 | 0 | 1 |
| F | Reconstruct NH 28 | 0 | 0 | 0 | 0 |
| F | Relocate NB Ramps | 0 | 0 | 0 | 0 |
| F | Park & Ride (Option 1: Adjacent to I-93 ROW) | 0 | 1 | 0 | 1 |
| F | Park & Ride (Option 2: Adjacent to Symmes Dr) | 0 | 4 | 0 | 4 |
| F | Park & Ride (Option 3: Adjacent to Perkins Rd) | 0 | 0 | 0 | 0 |
| F | Park & Ride (Option 4: SE quadrant) | 0 | 1 | 0 | 1 |
| F | Park & Ride (Option 5: NE quadrant) | 1 | 0 | 1 | 0 |

1 This acquisition is also included in Segment D, Options 7, 8 and 9.

In the majority of cases, however, property to be purchased will not involve the acquisition of buildings and the relocation of businesses or homeowners. Such purchases involve the partial acquisition of properties, with the remaining property still available to serve a residential, commercial or industrial use in accordance with the applicable zoning. The acreage of land to be acquired in partial acquisitions is estimated in total to be 346 acres. Table 4.11-2 presents a breakdown by municipality of the partial acquisition acreage to be acquired. In general, the purchase of this property will adversely affect the value of the property with respect to property taxes only to the degree that the use of the property is adversely affected.

**Table 4.11-2**
**Partial Acquisitions**

| Town | Acres |
|---|---|
| Salem | 70 |
| Windham | 170 |
| Derry | 20 |
| Londonderry | 82 |
| Manchester | 4 |
| Total | 346 |

### 4.11.1.3 Demographic, Housing, and Employment

Direct impacts to local and regional demographics as a result of any of the full-Build Alternatives are not anticipated. The maximum number of residences to be displaced, considering all the options, is 22 residences for any of the full-Build Alternatives. At the average Salem-Windham family size of 3.2 persons, where the majority of potential relocations occur, this equates to a potential impact of 74 persons. This equals only 0.04% of the study corridor's 5-town total population of approximately 203,000. It is believed likely that any residential relocation caused by these alternatives and their options can be satisfied within the study area.

Relocation of displaced people to other areas within the corridor's study towns should not be hampered by the availability of safe and sanitary housing. Given that the scale of potential residential relocation is 18-22 units, and that the available 2000 housing stock within the study area was approximately 2,950 units, there should be adequate replacement residential units available (Table 4.11-3). At the same time, new construction has continued to add new units to the housing stock.

**Table 4.11-3**
**Vacant Residential Units**

| Town | Vacant Residential Units | |
|---|---|---|
| | Number | Percent |
| Salem | 464 | 4.3 |
| Windham | 338 | 8.7 |
| Derry | 408 | 3.2 |
| Londonderry | 95 | 1.2 |
| Manchester | 1,645 | 3.6 |
| Total | 2,950 | |

Source: 2000 US Census

Given the scale of residential displacement, there should be no housing market distortion in the neighborhoods to which the displaced people are likely to relocate.

The maximum number of relocated businesses, considering all the options, is 18 businesses for any of the full-Build Alternatives. It is believed likely that any business relocation caused by these alternatives and their options can also be satisfied within the study area. There also appears to be commercially zoned areas suitable for businesses being displaced by the widening and associated interchange reconstruction. The degree to which owners feel that available alternative sites are not suitable is a source of concern, particularly for such businesses that are heavily dependent on drive-by traffic (such as gas stations, fast food, etc.) or subject to permitting requirements.

In terms of addressing individual needs, refer to Section 4.11.1.7 Mitigation.

Therefore, no net impact to demographic, housing or employment levels are anticipated under any of the alternatives.

There may be secondary impacts to local and regional demographics, which are discussed in Section 4.12.

### 4.11.1.4 Existing Land Use Patterns

Existing land use patterns have been developed over time, influenced primarily by the real estate market, road access and local regulatory decisions, that is, zoning and other land use controls. Improvements to I-93 should not cause any fundamental shift in land use patterns. Development along the highway will likely continue to develop as it is today. Land in the area of interchanges will also continue to be developed as it has been.

Residential uses adjacent to interchanges will be under increasing pressure in regard to conversion to commercial or industrial use, and it will be up to the community to decide what changes may be appropriate. In the case of Salem, those residential areas near the proposed park and ride lots will be under increased pressure to be rezoned. The Town will likely resist this pressure. In the areas of Exits 3, 4 and 5, the current zoning will probably continue for the foreseeable future. Continued development and redevelopment are expected on commercially and industrially zoned property.

### 4.11.1.5 Community Facilities

Community facilities within the I-93 study corridor vary from community to community, but typically include such things as police and fire stations, schools, municipal buildings, post office, hospitals, libraries, public works facilities, waste water treatment facilities, museums, cemeteries, airports, etc. There are no direct impacts to any of these types of community facilities.

### 4.11.1.6 Tax Base

Various potential alternative improvements to I-93 require the purchase of homes and businesses. One of the results of such purchases is to remove local real estate tax base from the community. The impact of this tax base loss is measured by totaling the assessed value represented by these purchased properties. Partial acquisitions are not included here because each remaining property is still available to serve a residential, commercial or industrial use, and still retains most of its assessed value.

The Three-Lane and Four-Lane Alternatives necessitate the purchase of the same properties. The optional improvements for each road segment, however, do necessitate that different properties be acquired. The following Table 4.11-4 lists the complete acquisitions and includes the NHDOT parcel number, the municipalities' tax parcel number by which the assessor knows the parcel, the parcel's use, the parcel's assessment as recorded in current (February 2002) tax assessment records, and the parcel's size. The total assessment is also provided for each particular improvement. The options making up the preferred alternative are shown in bold type.

**Table 4.11-4**
**2002 Real Property Tax Assessments and Parcel Size**

| Town | Segment | Description/ Option | NHDOT Parcel # | Town Tax Parcel # | Use[1] | Parcel Assessment | Total Assessment | Parcel Size | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| **Salem** | **A** | **South of Cross St.** | **S-10** | **142-9335** | **R** | **143,700** | **143,700** | **0.54** | **0.54** |
| | B | Reconstruct | S-17 | 135-8922 | R | 191,300 | | 1.94 | |
| | | | S-37 | 134-8865 | R | 125,700 | | 0.45 | |
| | | | S-38 | 134-8866 | V | 59,200 | | 1.92 | |
| | | | S-42 | 134-1682 | R | 265,200 | 671,400 | 1.32 | 5.63 |
| | | **Relocate** | **S-17** | **135-8922** | **R** | **191,300** | | **1.94** | |
| | | | **S-37** | **134-8865** | **R** | **125,700** | | **0.45** | |
| | | | **S-38** | **134-8866** | **V** | **59,200** | | **1.92** | |
| | | | **S-42** | **134-11682** | **R** | **265,200** | | **1.32** | |
| | | | **S-43** | **134-11680** | **R** | **265,000** | **906,400** | **1.00** | **6.63** |
| | C | Loop | S-60 | 115-8763 | R | 125,100 | | 0.20 | |
| | | | S-69 | 115-7763 | R | 196,400 | | 1.10 | |
| | | | S-78 | 97-7851 | R | 633,400 | | 8.55 | |
| | | | S-81 | 97-7847 | C | 292,600 | | 0.64 | |
| | | | S-182 | 116-7758 | R | 222,400 | 1,469,900 | 1.00 | 11.49 |

## Table 4.11-4 (continued)

| Town | Segment | Description/ Option | NHDOT Parcel # | Town Tax Parcel # | Use[1] | Parcel Assessment | Total Assessment | Parcel Size | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| | | **Diamond** | **S-60** | **115-8763** | **R** | **125,100** | | **0.20** | |
| | | | **S-69** | **115-7763** | **R** | **196,400** | | **1.10** | |
| | | | **S-81** | **97-7847** | **C** | **292,600** | | **0.64** | |
| | | | **S-182** | **116-7758** | **R** | **222,400** | **836,500** | **1.00** | **2.94** |
| | | **Exit 2 Park & Ride (East of NB lanes)** | **S-151** | **97-4424** | **R** | **129,900** | | **2.00** | |
| | | | **S-152** | **97-4423** | **R** | **119,500** | | **0.51** | |
| | | | **S-153** | **97-4422** | **R** | **159,200** | | **0.66** | |
| | | | **S-154** | **97-4421** | **V** | **51,400** | | **0.57** | |
| | | | **S-155** | **97-4419** | **R** | **268,399** | | **3.02** | |
| | | | **S-156** | **97-4417** | **V** | **4,900** | | **0.43** | |
| | | | **S-157** | **97-4416** | **R** | **119,400** | | **0.34** | |
| | | | **S-158** | **97-4415** | **R** | **104,800** | | **0.34** | |
| | | | **S-169** | **97-7865** | **R** | **137,000** | | **1.75** | |
| | | | **S-173** | **97-7866** | **C** | **155,900** | **1,250,399** | **1.62** | **11.24** |
| **Windham** | **D** | NB Shift #1 (Option 1) | W-46 | 11-C-1 | V | 101,000 | | 0.38 | |
| | | | W-47 | 11-C-6 | V | 77,000 | | 1.20 | |
| | | | W-95 | 12-A-550 | C | 932,000 | | 1.70 | |
| | | | W-99 | 17-G-2 | C | 550,000 | | 1.03 | |
| | | | W-100 | 17-G-1 | C | 816,000 | | 2.66 | |
| | | | W-104 | 17-G-45 | C | 168,000 | | 0.97 | |
| | | | W-105 | 17-G-41 | C | 379,000 | 3,023,000 | 1.27 | 9.21 |
| | | NB Shift #2 (Option 2) | | | | Same as Option 1 | | | |
| | | NB Shift #3 (Option 3) | W-35 | 11-C-425 | C | 385,000 | | 4.78 | |
| | | | W-44 | 11-C-12 | C | 539,000 | | 2.10 | |
| | | | W-45 | 11-C-5 | R | 133,000 | | 0.94 | |
| | | | W-46 | 11-C-1 | V | 101,000 | | 0.38 | |
| | | | W-47 | 11-C-6 | V | 77,000 | | 1.20 | |
| | | | W-95 | 12-A-550 | C | 932,000 | | 1.70 | |
| | | | W-99 | 17-G-2 | C | 550,000 | | 1.03 | |
| | | | W-100 | 17-G-1 | C | 816,000 | | 2.66 | |
| | | | W-104 | 17-G-45 | C | 168,000 | | 0.97 | |
| | | | W-105 | 17-G-41 | C | 379,000 | 4,080,000 | 1.27 | 17.03 |
| | | NB Shift #4 (Option 4) | | | | Same as Option 3 | | | |
| | | NB Shift #5 (Option 5) | W-35 | 11-C-425 | C | 385,000 | | 4.78 | |
| | | | W-43 | 11-C-13 | C | 600,000 | | 1.49 | |
| | | | W-44 | 11-C-12 | C | 539,000 | | 2.10 | |
| | | | W-45 | 11-C-5 | R | 133,000 | | 0.94 | |
| | | | W-46 | 11-C-1 | V | 101,000 | | 0.38 | |
| | | | W-47 | 11-C-6 | V | 77,000 | | 1.20 | |
| | | | W-95 | 12-A-550 | C | 932,000 | | 1.70 | |
| | | | W-99 | 17-G-2 | C | 550,000 | | 1.03 | |
| | | | W-100 | 17-G-1 | C | 816,000 | | 2.66 | |
| | | | W-104 | 17-G-45 | C | 168,000 | | 0.97 | |
| | | | W-105 | 17-G-41 | C | 379,000 | 4,680,000 | 1.27 | 18.52 |
| | | NB Shift #6 (Option 6) | | | | Same as Option 5 | | | |

## Table 4.11-4 (continued)

| Town | Segment | Description/ Option | NHDOT Parcel # | Town Tax Parcel # | Use[1] | Parcel Assessment | Total Assessment | Parcel Size | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| | | NB/SB Tight | W-46 | 11-C-1 | V | 101,000 | | 0.38 | |
| | | Shift #7 | W-47 | 11-C-6 | V | 77,000 | | 1.20 | |
| | | (Option 7) | W-95 | 12-A-550 | C | 932,000 | | 1.70 | |
| | | | W-99 | 17-G-2 | C | 550,000 | | 1.03 | |
| | | | W-100 | 17-G-1 | C | 816,000 | | 2.66 | |
| | | | W-101[2] | 17-G-6 | V | 252,400 | | 7.48 | |
| | | | W-102[3] | 17-G-20 | R | 49,200 | | 1.40 | |
| | | | W-103 | 17-G-26 | C | 835,000 | | 4.71 | |
| | | | W-104 | 17-G-45 | C | 168,000 | | 0.97 | |
| | | | W-105 | 17-G-41 | C | 379,000 | | 1.27 | |
| | | | W-106 | 17-G-40 | C | 370,000 | 4,529,600 | 17.00 | 39.80 |
| | | **NB/SB Tight** | **W-35** | **11-C-425** | **C** | **385,000** | | **4.78** | |
| | | **Shift #8** | **W-44** | **11-C-12** | **C** | **539,000** | | **2.10** | |
| | | **(Option 8)** | **W-45** | **11-C-5** | **R** | **133,000** | | **0.94** | |
| | | | **W-46** | **11-C-1** | **V** | **101,000** | | **0.38** | |
| | | | **W-47** | **11-C-6** | **V** | **77,000** | | **1.20** | |
| | | | **W-95** | **12-A-550** | **C** | **932,000** | | **1.70** | |
| | | | **W-99** | **17-G-2** | **C** | **550,000** | | **1.03** | |
| | | | **W-100** | **17-G-1** | **C** | **816,000** | | **2.66** | |
| | | | **W-101[2]** | **17-G-6** | **V** | **252,400** | | **7.48** | |
| | | | **W-102[3]** | **17-G-20** | **R** | **49,200** | | **1.40** | |
| | | | **W-103** | **17-G-26** | **C** | **835,000** | | **4.11** | |
| | | | **W-104** | **17-G-45** | **C** | **168,000** | | **0.97** | |
| | | | **W-105** | **17-G-41** | **C** | **379,000** | | **1.27** | |
| | | | **W-106** | **17-G-40** | **C** | **370,000** | **5,586,600** | **17.00** | **47.02** |
| | | NB/SB Tight | W-35 | 11-C-425 | C | 385,000 | | 4.78 | |
| | | Shift #9 | W-43 | 11-C-13 | C | 600,000 | | 1.49 | |
| | | (Option 9) | W-44 | 11-C-12 | C | 539,000 | | 2.10 | |
| | | | W-45 | 11-C-5 | R | 133,000 | | 0.94 | |
| | | | W-46 | 11-C-1 | V | 101,000 | | 0.38 | |
| | | | W-47 | 11-C-6 | V | 77,000 | | 1.20 | |
| | | | W-95 | 12-A-550 | C | 932,000 | | 1.70 | |
| | | | W-99 | 17-G-2 | C | 550,000 | | 1.03 | |
| | | | W-100 | 17-G-1 | C | 816,000 | | 2.66 | |
| | | | W-101[2] | 17-G-6 | V | 252,400 | | 7.48 | |
| | | | W-102[3] | 17-G-20 | R | 49,200 | | 1.40 | |
| | | | W-103 | 17-G-26 | C | 835,000 | | 4.11 | |
| | | | W-104 | 17-G-45 | C | 168,000 | | 0.97 | |
| | | | W-105 | 17-G-41 | C | 379,000 | | 1.27 | |
| | | | W-106 | 17-G-40 | C | 370,000 | 6,186,600 | 17.00 | 48.51 |
| | | **Exit 3 Park & Ride (Between SB & NB lanes, or East** | **W-101[2]** | **17-G-6** | **V** | **1,009,600** | | **29.92** | |
| | | **of NB lanes)** | **W-102[3]** | **17-G-20** | **R** | **246,000** | **1,255,600** | **7.48** | **37.40** |
| **Derry/ Londonderry** | **E** | **East** | **D-10** | **1-019-009** | **R** | **157,300** | | **1.02** | |
| | | | **D-11** | **1-019-008** | **R** | **165,400** | | **2.04** | |
| | | | **D-24** | **107-0218 A** | **C** | **138,900** | | **0.00** | |
| | | | **L-174** | **10-86** | **C** | **137,900** | | **1.70** | |
| | | | **L-178** | **10-149** | **R** | **131,600** | **731,100** | **2.00** | **6.76** |

## Table 4.11-4 (Continued)

| Town | Segment | Description/ Option | NHDOT Parcel # | Town Tax Parcel # | Use[1] | Parcel Assessment | Total Assessment | Parcel Size | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| | | West | D-10<br>D-11<br>D-24<br>L-37<br>L-174 | 1-019-009<br>1-019-008<br>107-0218A<br>10-26<br>10-86 | R<br>R<br>C<br>R<br>C | 157,300<br>165,400<br>138,900<br>146,600<br>137,900 | 746,100 | 1.02<br>2.04<br>0.00<br>1.11<br>1.70 | 5.87 |
| **Londonderry / Manchester** | **F** | Relocate NH 28 | L-130 | 16-66 | C | 1,305,100 | 1,305,100 | 8.21 | 8.21 |
| | | **Reconstruct NH 28** | **-** | **-** | **-** | **-** | **0** | **-** | **0** |
| | | Relocate NB Ramps | - | - | - | - | 0 | - | 0 |
| | | Exit 5 Park & Ride (Option #1: Adjacent to I-93 ROW) | L-82 | 15-56 | C | 1,332,300 | 1,332,200 | 12.79 | 12.79 |
| | | **Exit 5 Park & Ride (Option #2: Adjacent to Symmes Dr)** | **L-75<br>L-79<br>L-80<br>L-81** | **15-61-1<br>15-61-5<br>15-61-4<br>15-58** | **C<br>C<br>V<br>C** | **270,200<br>543,000<br>256,100<br>588,700** | **1,658,000** | **1.00<br>1.80<br>3.84<br>2.58** | **9.22** |
| | | Exit 5 Park & Ride (Option #3: Adjacent to Perkins Rd) | No values, as this option does not include the acquisition of homes or businesses. | | | | | | |
| | | Exit 5 Park & Ride (Option #4: SE quadrant) | L-129<br>L-130 | 16-73<br>16-66 | <br>C | 107,300<br>1,305,100 | 1,412,400 | 0.52<br>8.21 | 8.73 |
| | | Exit 5 Park & Ride (Option #5: NE quadrant) | L-97<br>L-98 | 16-9-1<br>16-9-2 | R<br>V | 137,000<br>64,574[4] | 210,574 | 1.00<br>16.00 | 17.00 |
| | | | **Preferred Alternative Totals** | | | | **12,368,299** | | **121.75** |

NOTES:

1 R Residential Use
C Commercial Use
V Vacant property

2 A complete acquisition, but divided between that purchased for segment option (20%) and that for park & ride lot (80%).

3 A large, but partial acquisition, divided between that purchased for segment option (10%) and that for park & ride lot (50%).

4 This property is classified as in Current Use and does not reflect a comparative assessed value.
Bold type indicates Preferred Alternative.

The total real property tax assessment value that will be removed from each community's tax base will vary depending upon the particular road improvement that is constructed. The range for the total five-community area varies from a low of about $8 million to a high of $15 million.

In Salem, for road segments A, B, C and the Exit 2 Park and Ride Lot, this assessed value of real property purchased will range from a low of $3 million to a high of $3.8 million. The Preferred Alternative represents an assessed value of $3.1 million. In Windham, for highway segment D and the Exit 3 Park and Ride Lot, the assessed value of real property purchased will range from a low of $4.3 million to a high of $7.4 million. The Preferred Alternative represents an assessed value of $6.8 million. In Derry, for a portion of road segment E, the assessed value of real property purchased is approximately $0.5 million and does not vary by alternative. In Londonderry, for the remaining portion of road segment E, all of segment F and the Exit 5 Park and Ride Lot, the assessed value of real property purchased will range from a low of $0.5 million to a high of $3.2 million. However, because the low value includes one property assessed as in Current Use, a more reasonable assessment range is a low of $1.4 million to a high of $3.2 million. The Preferred Alternative represents an assessed value of $1.9 million. There are no complete acquisitions of property proposed in Manchester, so impacts to the tax base will be minimized.

The annual resultant lost tax revenue will depend upon each community's individual annual tax rate as applied to their lost assessment value. This loss takes place at the time of NHDOT's property purchase. More specifically, the tax assessment and 2001 taxes for the Preferred Alternative follow (Table 4.11-5).

**Table 4.11-5**
**Preferred Alternative 2001 Tax Real Property Tax by Town**

| Town | Segment | Proposed Acquired Properties | | | Town Wide | % of Town Wide |
|---|---|---|---|---|---|---|
| | | Assessed Value | Tax Rate | Taxes | Assessed Value | Value Lost |
| Salem | A | 143,700 | $19.15/ $1,000 | $62,952 | 2.52 billion | 0.1% |
| | B | 906,400 | of assessed | | | |
| | C | 986,800 | value | | | |
| | Exit 2 P&R | 1,250,399 | | | | |
| Subtotal | | $3,287,299 | | | | |
| Windham | D | 5,586,600 | $17.45/ $1,000 | $119,396 | 1.13 billion | 0.1% |
| | Exit 3 P& R | 1,255,600 | of assessed | | | |
| Subtotal | | $6,842,200 | value | | | |
| Derry | E | 461,600 | $27.34/ $1,000 | $12,620 | 1.85 billion | 0.0% |
| Subtotal | | $461,600 | of assessed | | | |
| | | | value | | | |
| Londonderry | E | 269,500 | $24.67/ $1,000 | $47,551 | 1.60 billion | 0.1% |
| | F | 0 | of assessed | | | |
| | Exit 5 P& R | 1,658,000 | value | | | |
| Subtotal | | $1,927,500 | | | | |
| Totals | | $11,586,599 | | $245,519 | 7.10 billion | 0.1% |

This loss in assessed value is a very minor portion of the Towns' total assessed value and is expected to be offset over time by the new growth and redevelopment expected to take place within these corridor towns. In addition, improved transportation infrastructure and adequate operational capacity along the corridor and at the interchanges will likely contribute to increased property values, and promote new growth and redevelopment.

#### 4.11.1.7 Mitigation

Property proposed for acquisition is appraised utilizing techniques recognized and accepted by the appraising profession and in conformity with the uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and applicable to new Hampshire State Law. The amount offered for partial acquisitions is the difference between the fair market value of the property before the highway is built and its value after the portion needed for the highway has been acquired. Completed appraisals are carefully reviewed by an independent appraiser to insure that requirements of condemnation law and acceptable appraisal methods are met. The displaced residences will be eligible for relocation benefits which include:

- Fair market value for acquired property
- Relocation advisory assistance services
- Payments for moving and relocation costs
- Replacement housing payments for home owners
- Residential mortgage interest differential payments and closing costs
- Replacement housing payments for tenants

The displaced businesses will be eligible for relocation benefits which include:

- Fair market value for acquired property
- Relocation advisory assistance services
- Payments for actual reasonable moving
- Business re-establishment costs

Should identifying affordable housing for any residents displaced by the Selected Alternative (owners or renters) within the existing housing stock and assistance programs prove unfeasible, last resort housing will be made available, if necessary, in accordance with Section 206 of the uniform Act and governing regulations. As part of the right-of-way acquisition process, particular attention will be given to the current residents of these properties to assure that the needs of the displaces are adequately addressed and the project will not knowingly discriminate against low-income and minority residents of the project area.

## 4.11.2 Cumulative Impacts

Cumulative impacts are the aggregate of impacts or ramifications associated with the widening of I-93 with the impacts associated with other planned projects in the region. In a position paper entitled *Secondary and Cumulative Impact Assessment in the Highway Project Development Process (FHWA 1992),* the following discussion of terminology is provided.

> Guidelines prepared by the Council on Environmental Quality (CEQ) for implementing NEPA broadly defined both secondary and cumulative impacts. Secondary effects are those that are "caused by the action and are later in time or further removed in distance but are still reasonably foreseeable" (40CFR 1508.8). Generally, these impacts are induced by the initial action. They comprise a wide variety of secondary effects such as changes in land use, water quality, economic vitality and population density. Cumulative effects are impacts which result from the incremental consequences of an action when added to other past and reasonably foreseeable future actions (40 CFR 1508.7). These impacts are less defined than secondary effects. The cumulative effects of an action may be undetectable when viewed in the individual context of direct and even secondary impacts, but nonetheless can add to other disturbances and eventually lead to a measurable environmental change.

The nature of secondary and cumulative impacts associated with future development makes them difficult to forecast or measure. Future land use is determined by many variables. Zoning, economic climate, community values, surrounding land use and regulations, as well as access, are all factors affecting future land use. Similarly, the same factors come into play when considering the possible other projects or developments of a regional nature that might come to fruition, contributing to cumulative impacts.

The issue of potential secondary land use impacts associated with the widening of I-93 is addressed in Section 4.12.1.

Typically, consideration of cumulative impacts involves listing other projects or developments of regional importance. The impacts associated with these projects when combined with the impacts associated with the widening of I-93 need to be recognized for the potential ramifications involved. With that in mind, such projects would seemingly involve the recently completed NH 101 limited access freeway from Manchester to the NH seacoast and the ongoing expansion of the Manchester Airport and the new access road proposed from the FE Everett Turnpike as it passes through Bedford, NH; the recently completed widening of the southern end of the FE Everett Turnpike in Nashua, NH and the ongoing widening of the Middlesex Turnpike (US Route 3) in MA from the NH border to I-495 and I-95; the ongoing initiatives in the City of Manchester following the construction of a new civic center; and the potential for major outdoor sport facilities like the minor league ballpark proposal for Manchester's river front. There are also a number of ongoing and planned important transportation related improvements, including the anticipated revival of passenger train service from Nashua, NH to Lowell and Boston, MA with possible future extensions of the service up through Manchester; the possible construction of a new Exit 4A Interchange along I-93 between Exits 4 and 5 providing traffic relief through downtown Derry and industrial expansion in the Derry/ Londonderry area east of I-93; the reconstruction and relocation of NH 111 east of I-93 Exit 3 Interchange in Windham, NH improving safety and capacity along this important east/west secondary highway; and future improvements to I-93 in northern MA as outlined in a study completed by the Merrimack Valley Planning Commission. In their totality, these projects in conjunction with the widening of I-93 from Salem to Manchester represent major improvements in infrastructure with long-term effects on the southeastern region of the State of New Hampshire.

Potential ramifications include the following:

1. A greatly improved transportation system for the southern tier of NH, facilitating the movement of people, goods, and services with positive implications for employment and the State's overall economy.

2. A stronger transportation relationship, both by road (including bus service) and airport, to the Boston, MA regional economy with its resulting economic strength and stability from increased diversity, resulting in a greater range of type of employment choices and a larger percentage of higher paying (technical and managerial) employment opportunities, but making quality education increasingly more important.

3. Renewed growth and development pressures from regional sources with which local municipal planning and regulation mechanisms must deal, with assistance from state and regional planning organizations.

4. Pressure for increased development density from infill development and redevelopment, particularly along the I-93 corridor, and greatest near its access points.

5. Increased pressure for conversion to commercial and industrial land uses, particularly along the I-93 corridor, and greatest near its access points.

6. A greater potential for additional separation of land uses within the corridor and the outlying towns, to the extent that Smart Growth principles are not embraced.

7. Potential future water shortages relating to larger demand, limits to production and the protection of water resources.

8. Potential loss of natural resources, such as open space and farmlands, from development.

9. Potential need for additional public facilities to serve a larger residential and business population.

10. Increasing property values from higher densities with which to fund additional public facilities, but also potentially increasing the burden on those with fixed incomes.

11. The potential loss of those elements that define today's landscape creating a town's perceived small-town rural character, including for example: rural separations between towns, a small building scale, stone walls and narrow rural roads.

The potential ramification of these cumulative impacts will not necessarily be negative, but will depend upon state and local governments' comprehensive planning and response.

■

### 4.11.3 Environmental Justice

Executive Order 12898 requires federal actions to address environmental justice in minority populations and low-income populations. This order requires the federal agencies, including the US Department of Transportation, to identify and address, as appropriate, their programs, policies or activities having disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

More specifically, projects having substantial effects on human health or the environment shall be undertaken in a manner that they do not have the effect of excluding persons from participation in, denying persons the benefits of or subjecting persons to discrimination because of their race, color or national origin.

This project does not create a new transportation corridor, and at most, calls for the purchase of 22 residential properties and 18 commercial properties, spread out over the entire (19.8 mile) length of the project. Given the reasonably high level of income, the general lack of minority or low-income populations within the study area, the few numbers of properties subject to complete acquisition and their dispersed nature along the study corridor, the provisions of Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, are not applicable to this project. Such populations are clearly not being disproportionately impacted by the alternatives being discussed in this DEIS.

In summary, therefore, this project exhibits environmental justice in that it does not affect singular areas or neighborhoods where populations of low income, or of specific races or color or national origin, live or work.

## 4.12 Secondary Land Use Impacts

### 4.12.1 Introduction

The purpose of this subsection is to evaluate the potential secondary land use impacts due to the proposed widening of I-93 between Salem and Manchester. The means by which these effects might be minimized or offset, as appropriate, also are discussed. As part of the evaluation, the general effects on environmental resources that would be most vulnerable to such secondary land use impacts are identified and discussed.

Secondary land use impacts are defined as those impacts caused by the proposed project that occur later in time and removed in distance, but are still reasonably foreseeable. For this project, secondary impacts may be more specifically defined as those impacts that may result from the I-93 improvements outside of the direct (or primary) property and resource impacts within the highway corridor and the construction footprint. Such impacts may occur due to the increased traffic capacity of I-93 and the resultant improved accessibility within the area influenced by the I-93 corridor in New Hampshire. Secondary impacts to natural resources would typically result from the conversion of existing undeveloped lands that contain such resources to residential, industrial, commercial and governmental land uses. In addition, secondary impacts can have a positive impact to socio-economic resources in terms of improving the potential for more housing and employment opportunities.

The analysis of secondary impacts is an evolving art more than it is a science. Federal agencies such as the Council on Environmental Quality (CEQ) and the Federal Highway Administration (FHWA), while attempting to provide guidance, have concluded in position papers (FHWA April 1992) that there is no one correct way, nor a prescribed specific technique or method, that must be used to conduct such analysis. Indeed, each secondary impacts analysis is tailored to the needs of a particular locale and project. Such is the case here. For this analysis, an Expert Panel was convened using a process known as the Delphi Technique[38] to allocate (not predict) future growth in the Study Area for the year 2020 for the No-Build and Build Alternatives. The Panel was used to provide an objective and independent view of the future of the Study Area; the process is explained in detail in Subsections 4.12.4 and 4.12.5.

The need for such analyses of secondary impacts has emerged because of the concern that increasing accessibility by improving transportation infrastructure can enhance development potential and the conversion of undeveloped land to urban and suburban land uses. Such has been the case nationwide with the completion of the

38 See Section 4.12-4 for description.

Interstate Highway System and such has been the case in southern New Hampshire since I-93 was built in the late 1960's. Concurrent with other economic influences, the new highway helped spur development in its corridor.

Due to continued growth in the corridor and beyond, the design capacity of I-93's four travel lanes (two northbound and two southbound) is exceeded during peak periods in the Salem-Manchester segment. The currently proposed project, while clearly not as dramatic as the original construction in terms of increasing accessibility, is intended to increase capacity by adding lanes to the existing highway, as well as to improve safety. Today, the I-93 highway corridor is well established and characterized by widespread suburban development. Accordingly, the relative degree of secondary impacts in southern New Hampshire would be expected to be less substantial in the next 20 years than was the case after the new highway was built. For example, using the Expert Panel's blended average allocations (see Subsection 4.12.5) of future population and employment growth by 2020 in the Secondary Impacts Study Area, the additional growth with the Build Alternative over the No-Build Alternative is in the 5% range.

Nevertheless, concern has been expressed that the suburban sprawl pattern of development would continue as a result of improved highway capacity and incremental decision-making by local communities in the Secondary Impacts Study Area (see definition in Subsection 4.12.3). To assess this concern and meet the requirements of the National Environmental Policy Act (NEPA) of 1969, potential secondary land use impacts have been considered and presented below.

## 4.12.2 Alternatives Considered

For the secondary land use impacts study, a No-Build Alternative and a full Build Alternative were considered. The full Build Alternative considered assumed the addition of two travel lanes to each of the existing northbound and southbound barrels between Salem at the Massachusetts State Line and Manchester at I-293. While space for a possible future rail line is provided in the design of the highway widening, passenger rail service in this highway corridor is not proposed at this time. All five existing interchanges in this highway segment are assumed to be improved, but no additional interchanges are proposed.

The No-Build Alternative assumed that no capacity improvements or substantial safety improvements would be constructed along I-93 from Salem to Manchester. Other highway and other transportation improvements as outlined in the State's Ten-Year Transportation Improvement Program were assumed to go forward to construction.

### 4.12.3 Definition of Secondary Impacts Study Area

The Secondary Impacts Study Area includes the five communities in which the I-93 improvements would be constructed as well as 24 others in the region between Tewksbury and Andover in Massachusetts to the south and Concord, NH to the north. The Study Area covers approximately 824 square miles.

The extent of the Study Area was initially based on recommendations provided by the Oversight Committee made up of representatives of several State and Federal Agencies and New Hampshire regional planning commissions (RPCs). Using a previous origin and destination survey and the expertise and knowledge of the Committee, a Study Area of 29 communities was proposed. The Study Area was the subject of further consideration by the members of the Expert Panel enjoined to consider the magnitude of potential growth in the region.

Discussion of secondary impacts is presented by addressing the five corridor towns in which I-93 is located and the remaining towns grouped by their regional planning agency area and then population size. See Table 4.12.1 and **Figure 4.12-1**, respectively, for a list and locations of the communities in the Study Area.

**Table 4.12-1**
**Secondary Impacts Study Area Municipalities by Area and Regional Planning Agencies (RPA)**

| Area | RPA | Municipalities |
|---|---|---|
| I-93 Project Corridor | Rockingham Planning Commission | Salem, Windham |
| | Southern NH Planning Commission | Derry, Londonderry, Manchester |
| New Hampshire (Study Area excluding I-93 Project Corridor) | Central NH Planning Commission | Allenstown, Bow, Concord, Dunbarton, Pembroke |
| | Nashua Regional Planning Commission | Pelham |
| | Rockingham Planning Commission | Atkinson, Danville, Hampstead, Sandown |
| | Southern NH Planning Commission | Auburn, Bedford, Candia, Chester, Deerfield, Goffstown, Hooksett, Raymond |
| Massachusetts (Study Area) | Merrimack Valley Planning Commission | Andover, Lawrence, Methuen, North Andover |
| | Northern Middlesex Council of Governments | Dracut, Tewksbury |

In addition, secondary impacts are discussed in a more general manner for three towns adjacent to and north of the Study Area: Canterbury, Boscawen and Loudon, as well as for three large regions still farther north of the Study Area: Dartmouth-

Sunapee, North Country and Lakes Region. Three members of the Expert Panel suggested these additional areas.

### 4.12.4 Expert Panel

An Expert Panel was used to estimate population and employment, which in turn were used as indicators to estimate secondary land use impacts. The process through which the individual panelists provided their assessment of growth involved the "Delphi Technique." A Delphi is a structured process in which participants (the Panel) provide their assessment of likely future events (in this case the impacts of potential transportation investments) by responding to several rounds of questionnaires or surveys. A moderator tallies and summarizes the results of each round and provides these results back to the panelists. The Panel members are then given an opportunity to revise their initial analyses based on a review of their fellow panelists' work. The Delphi is considered complete when the responses in repeated rounds of questioning do not markedly change. The panelists typically conduct their work independently and somewhat anonymously in an effort to allow for fully reflective responses to the survey question and subsequent responses.

The Panel members were selected from the following relevant professional and public interest groupings because of their knowledge about local and regional planning, development, and/or the influence of growth pressure:

- real estate including economic analysis, law and finance;
- academia including planning and environmental resource analysis representing the Universities of Massachusetts and New Hampshire; other professions involving regional planning, town planning and public utilities;
- environmental policy represented by public interest groups; and informed citizens from local planning boards and a regional water pollution agency.

The Project's Oversight Committee (convened by NHDOT), representing several State and Federal agencies and local officials suggested over 40 names of candidate panelists. All candidates were interviewed by telephone and 16 panelists were recommended, which resulted in the Panel selected.

The panelists were familiar with the corridor and the Study Area and each brought different strengths and areas of knowledge to bear for this task. Data and information were gathered and compiled in a briefing book to provide each Panel member with a common foundation of knowledge about the I-93 project and the proposed Study Area. The briefing book contained data, maps and information about the Study Area needed by the Panel to conduct their analysis. The data were gathered from a wide variety of sources including the following: New Hampshire agencies including the Office of State Planning (OSP), Department of Environmental

Services (DES) and the Department of Employment Security; the Massachusetts Geographic Information System (MassGIS) and the Massachusetts Institute for Social and Economic Research (MISER); the U.S. Bureau of Census and Department of Commerce; as well as the Urban Land Institute and recent market analysis of office park developments in New England. The University of New Hampshire Complex Systems Research Center at Durham provided data that it maintains as part of GRANIT, the Statewide GIS program. The data were used to prepare color maps for analytical and comparison purposes using GIS software.

As a prelude to the process, a kick-off meeting was held at the University of New Hampshire, Manchester on June 29, 2001 to explain and provide background information on the I-93 Project, explain the Delphi process, and provide the Panel the opportunity to ask questions before they began their analysis. The general public was invited to attend this and the two subsequent meetings of the Panel on October 27, 2001 and December 5, 2001.

The expert panel process had two distinct phases. The first phase consisted of an assessment of the likely growth within the 29 communities that would result under a No-Build Alternative. The second phase involved performing a similar assessment for the Build Alternative. The Panel assessed this development by allocating population and employment among the 29 municipalities. Two panelists included the additional towns of Boscawen, Canterbury, and Loudon and allocated population and employment accordingly.

Detailed information about the Panel's work is included in the "I-93 Manchester to Salem Expert Panel Analysis Final Report, December 28, 2001 (revised January 22, 2001.")

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## 4.12.5 Panel's Blended Average Allocations

As noted above, each phase consisted of two rounds. After each round all the panelists' allocations were summarized and presented to the other panelists anonymously along with the memos each panelist wrote to summarize their thoughts behind the allocations. After the first round of each phase, the panelists could reallocate population and employment after seeing other panelists' allocations and memos. At the end of each round, the panelists' allocations were summarized using a "blended" average. This figure averages the median and mean of each phase's allocation. By using the blended average, weight is given to the very high or low panelist allocations, but not as much as using the mean directly. Coincidentally, the Panel's blended average allocation for growth by 2020 under the No-Build Alternative is roughly equal to the 2020 projections of the OSP.

Table 4.12-2 computes the difference in the Panels' blended average allocations for the No-Build and Build Alternatives in 2020. The differences between the Panel's employment and population allocations, which are shown in **Figures 4.12-2 and**

**4.12-3**, are used as the base for land conversion evaluations. In general, the Panel's blended average allocation suggests that the proposed project would have a greater influence on residential growth than commercial and industrial growth in the Study Area by 2020.

As was noted by the panelists at the December 5, 2001 meeting, the individual panelists' findings represent "informed opinions" which cross a broad spectrum ranging from large additional increases in growth if the highway is widened to no additional increase in growth associated with the widening. The panelists provided individual opinions and not a group consensus. As such, the blended average allocation represents one convenient measure by which to consider the findings.

With that said, the blended average allocations in total for the entire 29-community Study Area indicates that the Build Alternative would result in an additional 5% increase in both population and employment growth. Leaving out the allocations specific to Massachusetts (MA), the Build Alternative would result in an additional

7% growth in both population and employment growth in New Hampshire. Considering just the 13 New Hampshire towns with current populations of 10,000 people or less, the 2000 population of 71,000 people increases under the No-Build Alternative to approximately 99,000 people, and under the Build Alternative, to 110,000 people. The Build Alternative would result in an additional 12% growth in population and 13% growth in employment. These smaller New Hampshire towns are located along the periphery of the Study Area, particularly in the north. On the other hand, for the five New Hampshire municipalities with current populations greater than 20,000, the 2000 population of 233,000 people increases under the No-Build Alternative to approximately 281,000 people, and under the Build, to approximately 297,000 people. The Build Alternative would result in an additional 6% growth in both population and employment.

In addition, the widening is expected to affect growth in New Hampshire more than in Massachusetts, although the six Massachusetts municipalities would experience some additional growth in population (2%) and employment (4%). The widening also is expected to result in a greater percentage of growth for the smaller more rural New Hampshire communities and somewhat smaller percentage of growth for the larger more urbanized New Hampshire communities.

**Table 4.12-2**
**Expert Panel Blended Average Allocations for Population and Employment in 2020 in the Secondary Impacts Study Area by Alternative**

| | Current (2000) | | No-Build Alternative (2020) | | Build Alternative (2020) | | No-Build to Build Difference | |
|---|---|---|---|---|---|---|---|---|
| Municipality | Population | Employment | Population | Employment | Population | Employment | Population | Employment |
| Allenstown | 5,000 | 400 | 5,971 | 610 | 6,472 | 711 | 501 | 101 |
| Andover, MA | 31,000 | 18,000 | 36,999 | 22,718 | 37,616 | 23,705 | 617 | 987 |
| Atkinson | 6,000 | 400 | 8,573 | 673 | 9,757 | 875 | 1,184 | 201 |
| Auburn | 5,000 | 400 | 7,133 | 825 | 8,865 | 1,047 | 1,732 | 221 |
| Bedford | 18,000 | 12,000 | 24,906 | 19,932 | 27,186 | 21,300 | 2,279 | 1,368 |
| Bow | 7,000 | 3,000 | 9,264 | 4,339 | 10,237 | 5,003 | 974 | 664 |
| Candia | 4,000 | 300 | 5,408 | 449 | 6,425 | 601 | 1,016 | 152 |
| Chester | 4,000 | 200 | 5,623 | 323 | 6,369 | 400 | 746 | 77 |
| Concord | 41,000 | 45,000 | 48,253 | 59,609 | 50,997 | 61,052 | 2,745 | 1,443 |
| Danville | 4,000 | 200 | 5,584 | 319 | 6,085 | 340 | 501 | 21 |
| Deerfield | 4,000 | 200 | 5,543 | 321 | 5,989 | 383 | 445 | 61 |
| Derry | 34,000 | 7,000 | 44,706 | 9,009 | 47,672 | 9,876 | 2,966 | 867 |
| Dracut, MA | 29,000 | 7,000 | 34,018 | 9,268 | 34,676 | 9,651 | 658 | 383 |
| Dunbarton | 2,000 | 100 | 2,765 | 214 | 3,061 | 284 | 295 | 71 |
| Goffstown | 17,000 | 3,000 | 21,394 | 4,523 | 23,328 | 4,913 | 1,934 | 390 |
| Hampstead | 8,000 | 1,000 | 12,520 | 1,870 | 13,970 | 2,041 | 1,450 | 171 |
| Hooksett | 12,000 | 6,000 | 15,794 | 8,555 | 17,455 | 9,497 | 1,661 | 942 |
| Lawrence, MA | 72,000 | 31,000 | 80,501 | 38,332 | 81,429 | 39,583 | 928 | 1,251 |
| Londonderry | 23,000 | 8,000 | 33,069 | 11,700 | 37,250 | 12,583 | 4,181 | 883 |
| Manchester | 107,000 | 60,000 | 117,672 | 82,182 | 121,438 | 87,883 | 3,766 | 5,702 |
| Methuen, MA | 44,000 | 35,000 | 50,917 | 41,691 | 52,304 | 43,355 | 1,387 | 1,664 |
| North Andover, MA | 27,000 | 31,000 | 31,842 | 36,391 | 32,856 | 37,644 | 1,014 | 1,253 |
| Pelham | 11,000 | 2,000 | 16,973 | 2,800 | 18,911 | 3,165 | 1,938 | 365 |
| Pembroke | 7,000 | 2,000 | 8,866 | 2,941 | 9,570 | 3,095 | 704 | 155 |
| Raymond | 10,000 | 2,000 | 13,723 | 3,313 | 14,600 | 3,464 | 877 | 152 |
| Salem | 28,000 | 13,000 | 37,774 | 17,864 | 39,587 | 19,008 | 1,813 | 1,145 |
| Sandown | 5,000 | 100 | 7,814 | 209 | 8,174 | 251 | 360 | 41 |
| Tewksbury, MA | 29,000 | 9,000 | 34,392 | 14,359 | 35,100 | 14,696 | 708 | 337 |
| Windham | 11,000 | 1,000 | 15,047 | 1,986 | 16,294 | 2,446 | 1,246 | 460 |
| TOTAL | 605,000 | 298,300 | 743,045 | 397,324 | 783,671 | 418,852 | 40,626 | 21,527 |

### 4.12.6 Land Conversion

In order to estimate the potential effect of secondary land use development on environmental resources in the Study Area, the following procedure was used:

1. Conversion of the Panel's blended average allocations for population and employment growth by 2020 into land area needed (in acres) to accommodate consequent secondary land use development;

2. Identification of the amount of available developable land in each community based on a review of community Master Plans and available buildout analyses;

3. Identification of the general location of where this secondary growth is officially desired as indicated by future land use plans (if included as part of the adopted master plan) and zoning district maps;

4. Identification of the general locations of environmental resources in the Study Area using available GIS data; and

5. Qualitative observation of whether the secondary land use development would affect these resources.

The following two subsections explain how the Panel's allocations were converted to acres of consequent residential, commercial, industrial and other land use development.

#### 4.12.6.1 Residential Land Conversion Assumptions

Local zoning data were analyzed to calculate an average lot size for single and multi-family development for each municipality. Zoning was used since it is the primary legal land use and density control officially delegated to local governments from the states. Existing density of development allowed by present zoning is assumed to be the same in 2020. The average lot size was used to convert the Panel's average blended allocations for population into the amount of land (in acres) required to accommodate the consequent residential development. It should be pointed out that the Panel was not given an upper limit for their allocations and in some cases may have allocated more people than buildout scenarios indicate.

Through the regional planning commissions, zoning data were provided for the towns in New Hampshire and the average single family and multi-family lot size according to each town's zoning were determined. The number of housing units in each town in the Study Area in 1998 was determined using housing permit data provided by the OSP through GRANIT. It is assumed for this analysis that the proportional mix of single family, multi-family, and manufactured housing in each town in 1998 will be the same in 2020. In the case of Bedford, a review of its 2001 master plan update indicates no future growth in multi-family housing and the calculations take this into consideration.

The six municipalities in the Massachusetts portion of the Study Area have completed buildout analyses. Rather than use zoning data to compute average lot size, the data from the buildout analyses were used in these communities for this calculation. These analyses compute the number of single and multi-family housing units in each community that would be required to reach total buildout. It is assumed that future development will be consistent with the percentage of each type of housing calculated in the buildout scenarios.

Household size has been decreasing in the Study Area since at least the 1980 census, though the rate of decrease has been slowing over time. To reflect this trend, it was assumed that the average household size in each municipality in the Study Area would be approximately 0.05 person less in 2020 than that recorded in the 2000 U.S. Census. The Panel's blended average allocation for population in 2020 was divided by the reduced household size to estimate the number of housing units needed to accommodate the allocated growth for the No Build and Build Alternatives.

For each municipality the average lot size for single family, multi-family and manufactured housing was multiplied by the number of units needed and then weighted by the proportion of that type of housing in the municipalities' housing stock. The three numbers were then added together to determine the estimated number of acres required to accommodate secondary residential growth.

**Table 4.12-3**
**Household Size Trends, 1990-2000, % Distribution of Housing Types in 1998 and Average Residential Lot Size**

| Town | 1990 Census Average Household Size | 2000 Census Average Household Size | 1998 % Single Family Housing[1] | 1998 % Multi Family Housing[1] | 1998 % Manufactured Housing[1] | Single Family Lot Size[2] | Multifamily Lot Size[3] | Manufactured Lot Size |
|---|---|---|---|---|---|---|---|---|
| Allenstown | 2.64 | 2.53 | 36.73% | 26.79% | 36.48% | 2.0 | 1 | 0.15 |
| Andover, Ma | 2.80 | 2.74 | 94.00% | 6.00% | 0.00% | 0.9 | 0.08 | 0.15 |
| Atkinson | 2.92 | 2.66 | 76.78% | 22.67% | 0.54% | 2.0 | 0.25 | 0.15 |
| Auburn | 3.14 | 2.96 | 94.11% | 4.16% | 1.73% | 2.5 | 1.25 | 0.15 |
| Bedford | 3.07 | 2.85 | 84.49% | 14.96% | 0.54% | 2.1 | N/A[4] | N/A[4] |
| Bow | 3.03 | 3.10 | 98.48% | 1.30% | 0.22% | 3.0 | 1.5 | 0.15 |
| Candia | 3.07 | 2.88 | 89.90% | 5.50% | 4.60% | 2.5 | 1.25 | 0.15 |
| Chester | 3.07 | 3.09 | 89.70% | 7.41% | 2.88% | 2.3 | 1.15 | 0.15 |
| Concord | 2.35 | 2.30 | 39.50% | 52.84% | 7.67% | 0.5 | 0.1 | 0.15 |
| Danville | 2.83 | 2.82 | 73.95% | 5.53% | 20.53% | 2.0 | 1.25 | 0.15 |
| Deerfield | 3.09 | 2.98 | 85.50% | 5.65% | 8.86% | 3.0 | 1.5 | 0.15 |
| Derry | 2.73 | 2.74 | 50.52% | 45.02% | 4.46% | 1.1 | 0.55 | 0.15 |
| Dracut, MA | 2.85 | 2.73 | 83.88% | 16.12% | 0.00% | 1.0 | 0.38 | 0.15 |
| Dunbarton | 2.74 | 2.73 | 91.48% | 5.87% | 2.65% | 5.0 | 2 | 0.15 |
| Goffstown | 2.71 | 2.64 | 68.73% | 25.92% | 5.35% | 0.9 | 0.45 | 0.15 |
| Hampstead | 2.85 | 2.72 | 74.33% | 17.58% | 8.09% | 1.1 | 0.55 | 0.15 |
| Hooksett | 2.70 | 2.63 | 62.21% | 29.27% | 8.52% | 2.6 | 1.3 | 0.15 |
| Lawrence, MA | 2.83 | 2.90 | 64.00% | 36.00% | 1.00% | 0.2 | 0.1 | 0.15 |
| Londonderry | 3.10 | 3.05 | 68.22% | 24.14% | 7.64% | 1.0 | 0.5 | 0.15 |
| Manchester | 2.40 | 2.36 | 36.06% | 62.88% | 1.07% | 0.5 | 0.25 | 0.15 |
| Methuen, MA | 2.69 | 2.62 | 88.00% | 12.00% | 0.00% | 1.1 | 0.2 | 0.15 |
| North Andover, MA | 2.71 | 2.61 | 99.00% | 1.00% | 0.00% | 1.4 | 0.25 | 0.15 |
| Pelham | 3.24 | 3.03 | 85.54% | 13.62% | 0.84% | 2.1 | 0.5 | 0.15 |
| Pembroke | 2.68 | 2.59 | 59.33% | 36.20% | 4.47% | 1.8 | 1.6 | 0.15 |
| Raymond | 2.91 | 2.77 | 57.56% | 19.77% | 22.68% | 1.1 | 0.55 | 0.15 |
| Salem | 2.79 | 2.69 | 68.77% | 23.13% | 8.10% | 0.6 | 0.43 | 0.15 |
| Sandown | 3.11 | 3.02 | 84.77% | 9.63% | 5.59% | 3.0 | 1.5 | 0.15 |
| Tewksbury, MA | 3.02 | 2.81 | 86.19% | 13.81% | 0.00% | 1.0 | 0.1 | 0.15 |
| Windham | 3.15 | 2.98 | 91.71% | 7.98% | 0.31% | 1.1 | 0.5 | 0.15 |

1.) Original Data Source: For NH municipalities, NH Office of State Planning. For MA municipalities, buildout surveys were used to compute this housing mix.
2.) Single-family default is .5 in cities AND 3 elsewhere if zoning not available from RPCs or GRANIT.
3.) Multifamily Lot Size defaults to .25 for Manchester and .5 elsewhere if zoning data not available.
4.) N/A: Not Applicable. The 2001 Master Plan update for Bedford indicates that are no more multi-family and manufactured residential lots available.

## Table 4.12-4
## Differences between Alternatives, Acres of Land Converted to Residential Development to Accommodate Panel's Blended Average Allocations for Population in 2020

| Town | Total Town Area in Acres | Developable Land Available in Acres(1) | No-Build Population Growth (2000-2020) | No-Build Residential Land Conversion (Acres)(2) | No-Build to Build Population Difference | No-Build to Build Residential Land Conversion (Acres)(2) |
|---|---|---|---|---|---|---|
| Allenstown | 13,167 | | 971 | 455 | 501 | 235 |
| Andover, MA | 20,583 | 4,743 | 5,999 | 1,993 | 617 | 205 |
| Atkinson | 7,258 | | 2,573 | 1,728 | 1,184 | 795 |
| Auburn | 18,438 | 8,652 | 2,133 | 1,941 | 1,732 | 1,576 |
| Bedford | 21,156 | 5,700 | 6,906 | 5,698 | 2,279 | 1,881 |
| Bow | 18,269 | | 2,264 | 2,428 | 974 | 1,044 |
| Candia | 19,557 | | 1,408 | 1,272 | 1,016 | 918 |
| Chester | 16,718 | 6,664 | 1,623 | 1,264 | 746 | 581 |
| Concord | 43,000 | | 7,253 | 928 | 2,745 | 351 |
| Danville | 7,569 | | 1,584 | 993 | 501 | 314 |
| Deerfield | 33,348 | 15,521 | 1,543 | 1,543 | 445 | 445 |
| Derry | 23,226 | 6,100 | 10,706 | 3,546 | 2,966 | 983 |
| Dracut, MA | 13,699 | 4,988 | 5,018 | 1,767 | 658 | 232 |
| Dunbarton | 20,046 | | 765 | 1,475 | 295 | 569 |
| Goffstown | 24,065 | | 4,394 | 1,387 | 1,934 | 610 |
| Hampstead | 9,014 | | 4,520 | 1,725 | 1,450 | 554 |
| Hooksett | 23,761 | | 3,794 | 3,223 | 1,661 | 1,411 |
| Lawrence, MA | 4,753 | 211 | 8,501 | 620 | 928 | 68 |
| Londonderry | 26,958 | 7,185 | 10,069 | 3,007 | 4,181 | 1,248 |
| Manchester | 22,355 | | 10,672 | 1,723 | 3,766 | 608 |
| Methuen, MA | 14,722 | 2,425 | 6,917 | 2,794 | 1,387 | 560 |
| North Andover, MA | 17,706 | 3,188 | 4,842 | 4,786 | 1,014 | 583 |
| Pelham | 17,151 | | 5,973 | 4,113 | 1,938 | 1,335 |
| Pembroke | 14,597 | | 1,866 | 1,312 | 704 | 495 |
| Raymond | 18,943 | | 3,723 | 1,168 | 877 | 275 |
| Salem | 16,569 | | 9,774 | 2,051 | 1,813 | 380 |
| Sandown | 9,232 | | 2,814 | 2,810 | 360 | 359 |
| Tewksbury, MA | 13,526 | 1,712 | 5,392 | 1,905 | 708 | 250 |
| Windham | 17,772 | | 4,047 | 1,594 | 1,246 | 491 |
| **TOTAL(3)** | **527,158** | **N/A(3)** | **138,045** | **60,563** | **40,626** | **19,356** |

(1) Developable Land Available from Regional Planning Commissions or individual towns, if available.
(2) Residential Land Conversion = Population growth in households X average lot size X 1.1 (to estimate an additional 10% of acreage would be needed for roads or other ROW).
(3) N/A Total not applicable since data were unavailable for all towns listed in column.

Although average lot size consistent with zoning is a logical tool to use to calculate the amount of land required to accommodate secondary growth, the amount of land disturbed or actually "developed" on a given lot (for buildings, lawn, driveways, pool, etc.) will be far less than total lot size. This is particularly relevant with large lot zoning, which is standard in the Study Area. For example, 23 of the 29 municipalities in the Study Area have single family zoning districts with lot sizes of 1 acre or larger; 11 of these have minimum lot sizes of 2 or more acres. Typically, construction of a single family residence "develops" or uses a portion of the parcel, perhaps 0.25 to .50 acres, with the rest of the parcel area remaining "undeveloped" or maintained as natural growth, forest, or wetland areas. This is especially evident for lot sizes larger than one acre. As a result, zoning used in this analysis provides a maximum estimate of how many acres would actually be removed from a natural state due to expected growth and potential secondary growth.

Based on the above assumptions and analyses, nearly 61,000 acres would be converted or committed to residential development in the 29-community Study Area by 2020 whether the highway is widened or not, and an additional 20,000 acres would be converted due to secondary impacts of the Build Alternative. (See Table 4.12-4.) It is important to note, however, that the actual amount of land affected could be in the 25 to 50 percent range of the overall amount.

### 4.12.6.2 Commercial/Industrial Land Conversion Assumptions

Commercial and industrial land conversions were computed in a range for each community as employees per acre is heavily dependent on both the specific type of activity and the number of scheduled shifts of workers. Employment in the Study Area can be classified as belonging to one of the following four general categories:

- Manufacturing,
- Warehouse/distribution/construction/transportation,
- Office/R&D/flexible space/finance/government, and
- Service/retail.

Using 1999 county level data for employment by sector from the U.S. Department of Commerce as a reference, these categories are assumed to represent 15, 15, 20 and 50 percent of future jobs, respectively, in the Study Area in 2020.

The employees per acre for each category of employment were determined from referencing many sources, notably Urban Land Institute data and recent market analyses of office parks in New England. A low and high range of acreage was computed for each community. The Panel's blended average allocation was divided by the high and low number of employees per acre for each type of employment and multiplied by the percentage of employment represented by each type of employment. The numbers were added together to compute the range of land required for commercial, industrial and governmental growth for each municipality.

Please note that the land conversions for commercial and industrial development also include governmental development in this analysis. The estimates of land area required for the above uses are considered at the high end of a range because

**Table 4.12-5**
**Differences between Alternatives, Acres of Land Converted to Accommodate Panel's Blended Average Allocations for Employment in 2020**

| | | | No-Build Alternative | | | Additional with Build Alternative | | |
|---|---|---|---|---|---|---|---|---|
| Town | Total Acres | Developable Land Available | Employment Growth | Acres at Low Density | Acres at High Density | Employment Growth | Acres at Low Density | Acres at High Density |
| Allenstown | 13,167 | | 210 | 8 | 5 | 101 | 4 | 2 |
| Andover, MA | 20,583 | 4,743 | 4,718 | 190 | 105 | 987 | 40 | 22 |
| Atkinson | 7,258 | | 273 | 11 | 6 | 201 | 8 | 4 |
| Auburn | 18,438 | 8,652 | 425 | 17 | 9 | 221 | 9 | 5 |
| Bedford | 21,156 | 5,700 | 7,932 | 320 | 176 | 1368 | 55 | 30 |
| Bow | 18,269 | | 1,339 | 54 | 30 | 664 | 27 | 15 |
| Candia | 19,557 | | 149 | 6 | 3 | 152 | 6 | 3 |
| Chester | 16,718 | | 123 | 5 | 3 | 77 | 3 | 2 |
| Concord | 43,000 | 6,664 | 14,609 | 589 | 325 | 1443 | 58 | 32 |
| Danville | 7,569 | | 119 | 5 | 3 | 21 | 1 | 0 |
| Deerfield | 33,348 | 15,521 | 121 | 5 | 3 | 61 | 2 | 1 |
| Derry | 23,226 | 6,100 | 2,009 | 81 | 45 | 867 | 35 | 19 |
| Dracut, MA | 13,699 | 4,988 | 2,268 | 91 | 50 | 383 | 15 | 9 |
| Dunbarton | 20,046 | | 114 | 5 | 3 | 71 | 3 | 2 |
| Goffstown | 24,065 | | 1,523 | 61 | 34 | 390 | 16 | 9 |
| Hampstead | 9,014 | | 870 | 35 | 19 | 171 | 7 | 4 |
| Hooksett | 23,761 | | 2,555 | 103 | 57 | 942 | 38 | 21 |
| Lawrence, MA | 4,753 | 211 | 7,332 | 295 | 163 | 1251 | 50 | 28 |
| Londonderry | 26,958 | 7,185 | 3,700 | 149 | 82 | 883 | 36 | 20 |
| Manchester | 22,355 | | 22,182 | 894 | 493 | 5702 | 230 | 127 |
| Methuen, MA | 14,722 | 2,425 | 6,691 | 270 | 149 | 1664 | 67 | 37 |
| North Andover, MA | 17,706 | 3,188 | 5,391 | 217 | 120 | 1253 | 50 | 28 |
| Pelham | 17,151 | | 800 | 32 | 18 | 365 | 15 | 8 |
| Pembroke | 14,597 | | 941 | 38 | 21 | 155 | 6 | 3 |
| Raymond | 18,943 | | 1,313 | 53 | 29 | 152 | 6 | 3 |
| Salem | 16,569 | | 4,864 | 196 | 108 | 1145 | 46 | 25 |
| Sandown | 9,232 | | 109 | 4 | 2 | 41 | 1 | 1 |
| Tewksbury, MA | 13,526 | 1,712 | 5,359 | 216 | 119 | 337 | 14 | 7 |
| Windham | 17,772 | | 986 | 40 | 22 | 460 | 19 | 10 |
| TOTAL | 527,158 | N/A | 99,024 | 3,989 | 2,203 | 21,527 | 867 | 479 |

redevelopment of existing sites and growth in existing structures have not been specifically factored into this analysis. For example, redevelopment of existing sites such as industries that would expand on their present site and in existing buildings, such as mills, which may also be attractive to smaller companies, were not assumed in the conversion calculations.

## 4.12.7 Locations of Growth

The following describes allocated growth for municipalities in the Study Area. The amount of growth described is the difference between the Expert Panel's blended average allocations for population and employment in 2020 for the Build and No-Build Alternatives. A category of "Other Areas" as defined by several Panel members, as already mentioned, also is included.

In general, the largest absolute growth in jobs and population would occur in the cities and large towns in the Study Area, whereas the largest percent change in growth would occur in the more rural municipalities away from the corridor.

For discussion purposes, the municipalities in the Study Area are considered in various groupings such as by state, corridor communities, population size, and regional planning agency service area. The number of people, jobs and acres involved has been rounded to the nearest 100 since absolute precision is unnecessary for this type of conceptual analysis.

In general, the locations of secondary land use development within the municipalities in the Study Area is predicated on local land use policy as reflected in local master plans and zoning. However, many of the local master plans do not include a future land use plan, so in these cases it is difficult to predict where local future growth would occur. In these situations, it is assumed that future development patterns will follow past trends, resulting in a combination of infill development and new development on the periphery of already developed areas and strip commercial development along major roads. In either case, the location of growth and secondary growth is under the control of local government. Land use decisions are made by them based on local priorities at the time.

### Massachusetts Municipalities

The Panel's blended average allocations show relatively modest population growth in the six Massachusetts municipalities in the Study Area as compared to the New Hampshire communities; only 5,300 more people with the Build Alternative than with the No-Build Alternative. In general, these municipalities are nearing buildout and are being developed at a higher density than most of the New Hampshire Study Area communities. Andover, Dracut, Lawrence, Methuen, North Andover and

Tewksbury would require approximately 2,200 more acres of land, in total, to accommodate allocated residential growth with the Build Alternative.

The conversion of the Panel's average blended allocation to acres required may exceed the buildout scenarios in some communities that were previously prepared by the local regional planning commissions. This is the case in four large Massachusetts municipalities (Lawrence, Methuen, North Andover and Tewksbury) where there seemingly is not enough developable acres remaining to accommodate either the No-Build or the Build allocations by the Panel. Some of this additional growth, however, could be accommodated by re-use of existing facilities in these communities, for which there is ample precedent in the Merrimack Valley.

The six Massachusetts communities would have approximately 5,900 more jobs with the Build Alternative than with the No-Build Alternative, according to the Panel's blended average employment allocations. Approximately 130 to 240 acres would be required to accommodate secondary commercial and industrial land uses. Methuen, Andover and Lawrence would gain more jobs than the other communities and the growth could be accommodated based on the current industrial and commercial land use patterns and zoning.

### New Hampshire Municipalities

In the 23 New Hampshire municipalities in the Study Area, approximately 35,300 more residents would be added by 2020 with the Build Alternative than with the No-Build Alternative, according to the Panel's allocations. This growth ranges from 295 persons in Dunbarton to nearly 4,200 persons in Londonderry. To accommodate this population, secondary residential development would involve approximately 17,500 more acres in total.

Approximately 15,700 more jobs would be added to these communities by 2020 with the Build Alternative than with the No-Build Alternative. To accommodate these new jobs in commercial, industrial and governmental developments the approximate amount of undeveloped land to be converted is between 350 and 610 acres in total.

### New Hampshire Project Corridor Municipalities

Using the Panel's blended average allocations, the five project corridor municipalities of Salem, Windham, Derry, Londonderry, and Manchester in total would experience population growth of approximately 14,000 more people with the Build Alternative than with the No-Build Alternative. This growth ranges from over 1,200 in Windham to nearly 4,200 in Londonderry. Based on the residential land conversion assumptions and methodology described in Section 4.12.6.1, these five municipalities would affect approximately 3,700 more acres, in total, to accommodate housing for these additional residents.

The five corridor municipalities would experience a growth of 9,100 more jobs with the Build Alternative than with the No-Build Alternative. Manchester would experience the most employment growth with over 5,700 jobs and Windham would experience the least with nearly 500 more jobs. In terms of commercial and industrial development to accommodate this additional employment, between approximately 200 and 400 acres of land would be required in these communities.

Based on a review of local master plans, zoning district maps and buildout analyses, if available, for each municipality, there appears to be sufficient available land area in most of the corridor municipalities to accommodate future growth. As an example, two I-93 corridor towns in New Hampshire have completed a recent inventory of available developable land, Londonderry has almost 7,200 acres and Derry has 6,100 acres, and future growth could involve nearly 4,400 acres in Londonderry and nearly 4,600 acres in Derry.

### New Hampshire Non-Corridor Municipalities

In the remaining 18 municipalities in New Hampshire in the Study Area approximately 21,300 more residents would be added by 2020 with the Build Alternative than with the No-Build Alternative, according to the Panel's allocations. To accommodate this population, secondary residential development would involve approximately 13,700 more acres in total.

Approximately 6,600 more jobs would be added to these communities by 2020 with the Build Alternative than with the No-Build Alternative. To accommodate these new jobs in commercial, industrial and governmental developments the approximate amount of undeveloped land to be converted is between 100 and 300 acres in total.

### Nashua Regional Planning Commission

Pelham is the only town within the Nashua Regional Planning Commission's service area that was included in the Study Area. While several communities within the planning commission's area are adjacent to Study Area municipalities, the communities are less directly affected by I-93 as they are closer to US Route 3 and the F. E. Everett Turnpike.

Using the Panel's blended average allocations, Pelham would experience population growth of approximately 1,900 more people with the Build Alternative than with the No-Build Alternative. This population growth would involve approximately 1,300 more acres, in total, to accommodate housing for these additional residents.

The town would experience an increase of 370 more jobs with the Build Alternative than with the No-Build Alternative and would require between approximately 10 and 15 acres of land to be accommodated.

### Rockingham Planning Commission

The Study Area towns within Rockingham Planning Commission areas are located in the southern tier of New Hampshire, or close to the State line.

The towns of Atkinson, Danville, Hampstead, Salem, Sandown and Windham would have approximately 6,600 more people in 2020 with the Build Alternative than with the No-Build Alternative, according to the Panel's blended average population allocations. To accommodate the population growth; approximately 2,900 more acres of land would be affected.

These six towns would have approximately 2,000 more jobs with the Build Alternative than with the No-Build Alternative, according to the allocations. High-density commercial/industrial development would require approximately 45 acres, in total, while low-density development would require approximately 81 acres, in total.

### Southern New Hampshire Planning Commission

Auburn, Bedford, Candia, Chester, Derry, Deerfield, Goffstown, Hooksett, Londonderry, Manchester, and Raymond are within the service area of the Southern New Hampshire Planning Commission. In general, existing development is concentrated near the Merrimack River and such highways as I-93, US 3 and NH 101.

Approximately 21,600 more people would be added to these communities by 2020 with the Build Alternative than with the No-Build Alternative, or about two-thirds of the total population growth in the study area, according to the Panel's average blended allocations. Corresponding residential development in these towns would involve approximately 10,500 more acres of land.

The Master Plan update in 2001 for Bedford indicates that no new multi-family housing can be constructed and the residential land conversion considers this statement. Bedford is already nearing full buildout so conversion of additional land due to secondary impacts may become an issue in the future.

Approximately 10,800 more jobs would be added to these communities with the Build Alternative than with the No-Build Alternative, according to the Panel's allocations. The amount of undeveloped land that would be converted to accommodate the corresponding commercial and industrial growth in these towns is between 200 and 400 acres in total depending on the density of development. Bedford, Derry, Hooksett, Londonderry, and Manchester are more urbanized areas and have direct access to I-93, or I-293, which helps to explain why they are expected to experience the greatest amount of employment growth resulting in the relatively large amounts of land area required for commercial and industrial development in these towns.

### Central New Hampshire Planning Commission

The Study Area municipalities of Allenstown, Bow, Concord, Dunbarton and Pembroke are in the Central New Hampshire Planning Commission service area. Approximately 5,200 more residents would be added to these communities by 2020 with the Build Alternative than with the No-Build Alternative, according to the Panel's allocations. Over half of this total would be in Concord. To accommodate this population, secondary residential development would involve approximately 2,700 more acres in total. Concord's residential growth is expected to be mostly in multi-family structures, requiring less land area than in Bow and Pembroke, for example, which would be mostly in single-family detached housing.

Approximately 2,400 more jobs would be added to these communities by 2020 with the Build Alternative than with the No-Build Alternative. Approximately 60 % of these new jobs would be in Concord. To accommodate these new jobs in commercial, industrial and governmental developments the approximate amount of undeveloped land to be converted is between 50 and 100 acres in total.

Bow, Pembroke, and Concord have relatively direct access to I-93. Concord, the most urbanized municipality in this region, has approximately 6,600 acres of developable land available. The other less developed towns appear to have ample developable land available.

### Other Areas

During the Expert Panel process two panelists included allocations for the towns of Boscawen, Canterbury and Loudon just north of Concord and the Study Area. The two panelists' blended average allocation anticipates secondary population growth of 500 people and secondary employment growth of 400 jobs in the three towns. These are modest increases even for these largely rural communities.

One panelist also mentioned three larger regions north of the Study Area; the Dartmouth/Lake Sunapee Region, the North Country and the Lakes Region, during meetings. This panelist was concerned about the impact of a widening I-93 on secondary home growth. Secondary home growth is based on several factors including the state of the economy, in particular in the Boston, Massachusetts area and southern New Hampshire. In addition, other highways besides I-93 provide access to these regions such as I-89 to the northwest and NH Route 16 in the east. The ease of access to an outlying region, also, in part, determines its attractiveness and consequent demand.

### Land Conversion by Size of Municipality

It is also useful to compare the secondary land use conversion by groups of similar sized municipalities in New Hampshire in terms of population, to better assess their relative ability to absorb both the growth allocated for the No-Build Alternative and the Build Alternative.

For the No-Build Alternative, using the panelists' blended average allocation, the thirteen municipalities in New Hampshire with populations of 10,000 people or less would experience a total population increase of approximately 27,800 people, requiring approximately 19,400 acres. Under the Build Alternative, the municipalities are expected to grow by another 10,800 people. This increase is estimated to result in the development of 8,200 more acres to accommodate this growth. These large amounts of land acreages directly correspond to large lot zoning in smaller, more rural communities.

For the five medium sized communities of between 10,000 and 20,000 people, a total population increase of approximately 25,100 persons is allocated under the No-Build Alternative, which will require roughly 16,000 acres. Under the Build Alternative the municipalities are expected to grow by another 9,100 people requiring 5,700 more acres to be accommodated. It appears that the relatively large amount of land to be affected is primarily due to the existing large lot zoning.

For the No-Build Alternative, using the panelists' blended average allocation, the five municipalities in the New Hampshire portion of the Study Area with populations above 20,000 are allocated a total population increase of approximately 48,500, which will require roughly 11,300 acres. Another 15,500 more people are expected in the Build Alternative, requiring 3,600 more acres. The amount of land required to accommodate this growth is considerably less than in the medium-sized and small-size towns, largely due to smaller lot size and higher density zoning in the larger communities.

By relating the amount of acreage to be affected to population size of municipality, it is clear that the larger communities have a higher density of development than the smaller communities. They accommodate the largest number of allocated people in the least amount of acreage. The larger municipalities have a larger percentage of multi-family dwelling units and smaller average lot size requirements for single family houses in their zoning ordinances. The smaller towns tend to be less dense and have larger minimum lot sizes for residences in their zoning, and less, if any, multi-family housing. The zoning codes, which are assumed to be unchanged in this analysis with regard to lot size specifications, form the basis of the calculations and the actual amount of land developed in each town may be less for reasons explained earlier.

A fact which is evident through the preceding discussion is that much of the growth in the Study Area is expected to occur regardless of whether I-93 is widened or not. Growth is expected to occur, even without the project, in response to other influences involving the overall quality of life conditions and continued economic prosperity found in New Hampshire. In addition, it is not clear whether the additional growth, and associated land conversion, under the Build Alternative is growth that otherwise would not occur, or growth that would simply occur later in time if the highway were not widened.

It should be noted that at least five communities in the Study Area appear to be reaching buildout and will have difficulty accommodating new growth as allocated by the Panel with or without the project, unless current zoning regulations are changed. Bedford, NH (population 18,000) has 5,700 acres of developable land, which would accommodate the No-Build allocations, but not the additional 1,700 acres with the Build Alternative. The larger Massachusetts communities of Lawrence, Methuen, North Andover and Tewksbury theoretically do not have enough developable land to accommodate the No-Build, let alone the Build allocations. This issue will be offset to some degree by infill development and conversion of existing sites and facilities to accommodate less space-intensive industries, or reuse of abandoned mill facilities. However, in general the issue does highlight the difficulty of predicting and evaluating future growth and associated land use.

### 4.12.8 Potential Secondary Land Use Impacts on Environmental Resources

The potential land use impacts on environmental resources that could be attributed to secondary growth in the Study Area are discussed in this subsection. Land development and associated impacts depend on general regional and statewide economic conditions, state permitting requirements, local zoning and land use ordinances and their administration, and the decisions of individual landowners. Given these influences and changing conditions over time, it is difficult to forecast with real confidence specific areas that may be developed or not, and the impacts of such development, under the No-Build and Build Alternatives. As a result, the ensuing discussion addresses secondary land use impacts on environmental resources qualitatively.

## Table 4.12-6
## Natural Resources by Alternative in the Study Area (in Acres)

| Town | Total | Conservation Lands[1] | NWI[2] | Unfragmented Tracts > 500 Acres[3] | Farm Land[4] | Developable Land Available[5] | Unprotected Priority Open Space[6] |
|---|---|---|---|---|---|---|---|
| Allenstown | 13,167 | 6,761 | 898 | 11,540 | 239 | | - |
| Andover | 20,583 | | | | | 4,743 | - |
| Atkinson | 7,258 | 663 | 590 | 2,629 | 477 | | 470 |
| Auburn | 18,438 | 4,206 | 3,687 | 12,663 | 436 | 8,652 | 6,010 |
| Bedford | 21,156 | 768 | 1,422 | 5,860 | 1,656 | 5,700 | - |
| Bow | 18,269 | 1,846 | 1,739 | 10,310 | 737 | | - |
| Candia | 19,557 | 1,642 | 1,588 | 15,376 | 279 | | 4,200 |
| Chester | 16,718 | 1,312 | 1,460 | 14,284 | 840 | 6,664 | 3,940 |
| Concord | 43,000 | 7,458 | 5,112 | 21,998 | 4,295 | | - |
| Danville | 7,569 | 454 | 1,277 | 5,199 | 168 | | 900 |
| Deerfield | 33,348 | 5,063 | 3,116 | 29,518 | 842 | 15,521 | 3,790 |
| Derry | 23,226 | 1,013 | 2,390 | 6,919 | 1,315 | 6,100 | 460 |
| Dracut | 13,699 | | | | | 4,987 | - |
| Dunbarton | 20,046 | 4,122 | 2,169 | 18,334 | 1,139 | | - |
| Goffstown | 24,065 | 1,765 | 1,300 | 15,131 | 1,852 | | - |
| Hampstead | 9,014 | 1,389 | 1,464 | 2,485 | 374 | | 420 |
| Hooksett | 23,761 | 2,963 | 2,095 | 15,744 | 684 | | 2,380 |
| Lawrence | 4,753 | | | | | 211 | - |
| Londonderry | 26,958 | 1,229 | 2,716 | 9,747 | 1,651 | 7,185 | 2,700 |
| Manchester | 22,355 | 1,269 | 2,234 | 3,067 | 807 | | 1,640 |
| Methuen | 14,722 | | | | | 2,425 | - |
| North Andover | 17,706 | | | | | 3,188 | - |
| Pelham | 17,151 | 1,092 | 2,334 | 8,061 | 933 | | 240 |
| Pembroke | 14,597 | 342 | 544 | 10,243 | 1,400 | | - |
| Raymond | 18,943 | 871 | 2,437 | 10,709 | 212 | | 2,410 |
| Salem | 16,569 | 642 | 2,553 | 2,575 | 551 | | 0 |
| Sandown | 9,232 | 284 | 1,353 | 5,855 | 213 | | 740 |
| Tewksbury | 13,526 | | | | | 1,712 | - |
| Windham | 17,772 | 641 | 1,968 | 8,935 | 612 | | 1,060 |
| Total | 527,158 | 47,795 | 46,453 | 247,170 | 21,710 | | |

(1) Conservation Lands excluding outlots. Source: New Hampshire Resource Protection Project, I-93 Corridor Wildlife Habitat Study; Audubon Society of New Hampshire/UNH Complex Systems Research Center
(2) Total National Wetland Inventory features. Source: USGS/GRANIT
(3) Unfragmented Tracts of Land greater than 500 Acres – some areas may be contiguous with NWI features and Conservation Lands. Source: New Hampshire Resource Protection Project, I-93 Corridor Wildlife Habitat Study.
(4) Agricultural land use acreage. Source: 2001 Land Cover Assessment, GRANIT
(5) From municipal master plan or build out scenario
(6) Priority open space areas not within conservation lands or not surface waters. Source: New Hampshire Resource Protection Project, I-93 Corridor Wildlife Habitat Study

### New Hampshire Municipalities with Developable Land Inventories

Five of the six New Hampshire municipalities in the Study Area, for which the amounts of remaining developable land were available in their master plans, or other studies, appear able to accommodate No-Build growth as well as Build (secondary land use) growth. The one exception is Bedford. As these estimates of developable acres have assumed that development in areas with sensitive environmental features would not occur, the direct impacts of growth should not adversely affect these resources. The municipalities of Auburn, Chester, Deerfield, Derry and Londonderry appear to have enough land to accommodate allocated growth. Londonderry and Derry are both towns in the I-93 project corridor. Of the five municipalities in the project corridor, these two will require the conversion of the most acreage for allocated secondary population growth associated with the Build Alternative.

Regarding the case of Bedford, its master plan indicates that there are 5,700 acres of developable land remaining, which excludes sensitive environmental resource acreage. Approximately the same amount of land (5,698 acres) would be converted to residential development, based on the Expert Panel's population allocation for the town under the No-Build Alternative. In other words, the town would be fully built out by 2020 even without the widening of I-93, with no expected impact on environmental resources. With the project (i.e., the Build Alternative) approximately 1,600 more acres would be required to accommodate the additional residential growth. Theoretically, it would not be possible to accommodate this additional growth given the town's current zoning. Further, this additional growth, if it were to occur without some change in current zoning regulation, would be expected to have impacts on environmental resources. These growth allocations reflect Bedford's strategic geographic location in a fast growing sector of the Manchester metropolitan area, and its easy access to many key highways and the Manchester Airport. With such growth potential, Bedford would have to modify its current zoning ordinance (and its Master Plan) to allow for development in sensitive resource areas and/or accommodate denser development, or conceivably if Bedford retains its current zoning, this growth potential may be diverted to other nearby communities.

In contrast to Bedford, Auburn would be able to accommodate all the allocated growth, with or without the project. Auburn has nearly 8,700 acres of remaining developable land. Total growth (No-Build plus Build for both residential and employment growth) would involve approximately 3,500 acres. As in Bedford, the Auburn developable land amount excludes environmental resources and constraints. However, indications are that Auburn (in spite of its proximity to Manchester and its access to NH101 and ultimately to I-93) can experience substantial growth, but do so without changing its current zoning ordinances, and without affecting sensitive environmental resources.

In Deerfield, nearly 16,000 acres of developable land is available, according to its master plan. In contrast, 2,000 acres would be affected by future growth assuming the highway is widened. Accordingly, this town has ample land available to accommodate this growth, with no undue impacts on sensitive environmental resources. Deerfield is located in the northeast portion of the Study Area and is among the more rural towns in the Study Area.

On the other hand, Atkinson with a total land area of approximately 7,260 acres and an existing population of 6,000 people is expected to see its population increase to 9,000 people affecting an additional 2,500 acres. There are no available estimates of available developable land in Atkinson, but given the limited size and relatively large increase in population and land use, its ability to accommodate such increases may be problematic.

### Municipalities without Developable Land Inventories

As highlighted in the discussion above relative to Atkinson, it is difficult at best to draw conclusions relative to what degree future growth will adversely affect environmental resources without some type of estimate of acreage of developable land. Environmental resources in rural municipalities with large land areas and relatively modest growth are less likely to be adversely affected. Those communities with smaller land areas and more substantial growth may experience more development pressure that could result in more substantial impacts to natural resources. There is no available accepted ratio or correlation between developed acres and acres of affected natural resources (e.g., wetlands). Development on a specific site is typically dependent on site specific resources, terrain and conditions, and generalizations as to what acreage of natural resource impacts might be expected per acreage of development are speculative. For instance, there are no studies prepared by the American Planning Association or the Urban Land Institute that have determined such a correlation.

The land use plans and zoning information for each municipality in New Hampshire were consulted at the OSP to understand where future development is officially expected or desired to occur. It is assumed for this study that all growth will occur within these planned future development areas in a manner generally consistent with these adopted plans. A review of these plans and information indicates that many, if not most, towns have enough land to accommodate future growth under the Build and No-Build Alternatives, particularly in the less populated, more rural communities.

An additional source of information relative to important natural resource areas in the New Hampshire segment of the Secondary Land Use Impacts Study Area, includes GIS data from a forthcoming co-occurrence study covering a large segment of southern New Hampshire. This co-occurrence study is independent from the work done for this EIS chapter. The co-occurrence study is being conducted by the Complex Systems Research Center of the University of New Hampshire and the New Hampshire Audubon Society for the U.S Environmental Protection Agency. The resources being considered in the co-occurrence study include: wildlife habitat areas, reptile and amphibian reporting program areas, conservation lands, large wetlands, vernal pools, surface water, unfragmented tracts, and The Nature Conservancy (TNC) portfolio features. A review of these data from the co-occurrence study showed that within the Secondary Land Use Study Area, these environmental resources are widespread and some of these resources function in combination (i.e., co-occur) as integral parts of larger environmental systems. Table 4.12-6 shows the acreage of the more important co-occurrence areas that are in the Study Area that may be subject to development pressures in the future.

The data in the co-occurrence study were not prepared to provide detailed impact analysis associated with future growth in New Hampshire. However, the data can be used to gauge the difficulty future growth may pose for the most valuable resource areas based on the communities' land areas, magnitude of future growth, and acreage of future land use. The maps created as part of the co-occurrence study are intended to help communities identify and become more aware of environmentally sensitive lands within their jurisdictions.

After mapping the known natural features to identify a first set of environmentally sensitive areas, and noting the degree of co-occurrence between various natural resources, the sponsors of the co-occurrence study invited natural resource experts from various natural resource agencies and organizations to identify a second set of areas that were most important to preserve from future development. In addition, conservation commissions from the 14 towns that the sponsors anticipated will experience large amounts of growth from the I-93 project selected a third set of areas.

The co-occurrence study sponsors then overlaid these three layers and 23 sites were identified as "priority" open spaces in the I-93 Secondary Land Use Impacts Study Area. These sites are those that overlapped at least two of the three sets of areas outlined above. The last column in Table 4.12-6 shows the acreage of these more important co-occurrence areas that are located on private property and may be potentially subject to some development pressure over time.

In considering municipalities without a developable land inventory, for this EIS, it is assumed that future growth will avoid the surface water features and National Wetland Inventory (NWI) wetlands. When these water resource areas are removed from consideration, enough acres of land appear to remain in most New Hampshire communities, to accommodate future development, according to the master plans. These resources exist throughout the Study Area and are located in no regular pattern. Some of these surface water features are also public water supplies, such as Massabesic Lake, Canobie Lake, and Arlington Mill Reservoir. Conservation and public lands already surround Massabesic Lake to protect its water quality. In fact, the protection of this resource has greatly affected the development pattern of Auburn, especially, according to the town's master plan, as development is channeled away from this resource. In general, it would be expected that these water resources would be protected from future development by existing wetland and stream protection regulations.

However, several of the master plans mention that the shores of lakes and ponds in the municipalities were originally developed for recreation use during the summer. As a result development in many towns tends to actually be higher around these large surface waters. Due to increased housing demand in municipalities, many of these seasonal homes have been converted for year round use though their septic systems have not been upgraded for the increased use. The town plans of Windham and Salem, for instance, both mention this fact.

Conservation lands are those where development is either prohibited or closely monitored. These areas are located in most of the communities in the Study Area in no particular pattern, but are generally near or include important water resources. The amount of conservation lands range from a low of just over 2 % in Pembroke to a high of 52 % in Allenstown. The high number for Allenstown is explained by the presence of Bear Brook State Park. Conservation lands would be expected to be protected from future growth due to existing regulations.

Unfragmented tracts of land greater than 500 acres in size are generally more prevalent in the northern, less developed, communities of the Study Area than in the southern more developed communities of the Study Area. Further, large contiguous areas of unfragmented tracts tend to be farther away from I-93 and the Merrimack River. These unfragmented tracts constitute good habitat for wildlife. The proportion of unfragmented tracts to total town size in acres range from a low of approximately 14 % in Manchester to a high of approximately 91 % in Dunbarton.

These large tracts are in communities where there may be a greater percentage growth in population, but smaller growth in terms of absolute numbers. Given the rural nature of these towns and large amounts of undeveloped land, their ability to absorb projected increases in additional population is good, however such growth may incrementally reduce the size of individual unfragmented tracts. If development occurs in scattered locations, the impacts on this resource will be greater than if development occurs in clusters. Because large tracts of privately owned unfragmented land are not restricted by permitting requirements from being developed, it would be expected that some future development will take place on these lands, adversely affecting, to some degree, the benefits such unfragmented lands contain.

Farmlands can experience increasing pressure to convert to residential use as the Study Area municipalities become more developed. Using land use data derived from the 2001 Land Cover Assessment produced by GRANIT (The State of New Hampshire's GIS system), the percentage of farm acres to total acres in a town in the Study Area range from approximately 1% in Raymond to 10% in Concord. In keeping with the general development pattern of the Study Area, higher concentrations of farmland are located in the north and farther away from I-93 and the Merrimack River, much like the unfragmented tracts. In addition, like the unfragmented tracts it would be expected that future growth will result in the loss of some farmland, reducing the quantity of this resource.

Lastly, another piece of information of interest is the fact that the NHDES keeps records of the acreage of wetlands impacts throughout New Hampshire in a year. Based on the criteria used to define wetland related impacts, approximately 150 acres of wetlands are currently affected per year, statewide, for all projects (public and private) taking place. Over a five-year period (1997 through 2001) NHDES records show that approximately 550 acres of wetland were lost, but that over 160 acres of wetlands were created or enhanced and 3,600 acres of upland and wetlands were protected under conservation easements or deed restrictions. While the widening of I-93 may accelerate or increase growth in New Hampshire to some degree, the additional impacts to wetlands would not appear to substantially change the magnitude of impacts that historically have occurred.

The U.S. Army Corps of Engineers keeps similar records from which, based on their criteria, data indicates that approximately 80 acres of wetlands are affected throughout the entire state per year. Further, these data indicate that the affected wetland acreage per year is decreasing over time, as developments become more sensitive to environmental considerations.

In general, future growth and associated land use impacts are expected to occur in areas planned by localities for future development, which are areas that do not necessarily contain valuable natural resources. Accordingly, future land use development (including that induced by the widening of I-93) cannot be assumed to take place in areas of important natural resources, such as those mapped in the co-occurrence study. The most vulnerable of these resources, such as wetlands and vernal pools, are protected by regulation, as are conservation lands. Further, there appears to be sufficient land to accommodate the land conversions computed for the No-Build and Build Alternatives in most of the communities in the New Hampshire segment of the Study Area. Large unfragmented tracts of land and farmland, however, are not necessarily protected in the Study Area. Though any new development may encroach on these lands, such development is expected to be in keeping with local planning in accordance with local priorities.

### Massachusetts Municipalities

In the Massachusetts segment of the Study Area, mapping of environmental resources was done as part of the buildout scenarios performed for each municipality. These resources were excluded from the developable land acreage in each. Wetland resources are located in all six municipalities and include the Merrimack River. The major surface water resources are Lake Cochichewick in northeast North Andover, Haggetts Pond in west Andover and scattered wetlands in southeast Andover and west Methuen. The largest tracts of conservation lands and unfragmented forests are in the southern sections of the adjacent towns of North Andover and Andover.

Future residential land use development, in these communities, is presumed to be in the nature of "infill", i.e., within largely already developed and appropriately zoned areas, since there are few large tracts of land areas that remain for substantive future development. Lawrence, the largest city, is virtually fully built out. While there are large tracts in northern Methuen, they are zoned for Agricultural/Conservation. In southern North Andover, a large undeveloped area is predominantly a 100-year flood zone. Based on the residential zoning district patterns, it appears that the important environmental resources are largely protected from future residential development impacts.

Future industrial and commercial development is expected to be located on land appropriately zoned for such uses. These areas are located near I-93 and I-495 and other major State highways. While some industrially zoned land is located near the Merrimack River (for instance in North Andover), environmental resources in these municipalities appear to be protected from future land use impacts as the locations of industrially zoned land in relation to the location of the mapped resources are appropriately planned.

## 4.12.9 Mitigation

Neither the Council on Environmental Quality (CEQ) regulations nor FHWA's environmental guidance documents implementing NEPA requires mitigation of secondary land use impacts associated with highway improvement projects. Specifically, the CEQ regulations are silent regarding the issue of mitigation for secondary impacts. FHWA policy as governed by 23 CFR 771.105, discusses mitigation in section (d)(1) and (2) for adverse impacts that actually result from a project and that the mitigation represents a reasonable public expenditure. The section does not specifically address mitigation for secondary impacts. In addition, the permitting requirements associated with Section 404(b)(1) guidelines governing the U.S. Army Corps of Engineers' permit are limited to requiring mitigation for secondary impacts that are quite specific and predictable relative to location and degree. More generalized secondary impacts like those associated with possible future growth in a region do not require mitigation. Further, there is little precedent nationwide where a State DOT has specifically mitigated secondary impacts for a proposed project. Instead, such potential impacts are identified, evaluated, and documented in relation to all other impacts so decision makers have pertinent information on hand to make decisions. This type of comprehensive evaluation of the full range of impacts to environmental, cultural, social, and economic resources is required under NEPA before State Highway Agencies, the FHWA and permitting agencies can make project decisions. Consideration of secondary land use impacts is one area under consideration in this process.

As previously stated, the secondary impacts associated with widening I-93 are difficult to predict and catalogue with any certainty or specificity. The evaluation process involves designating a study area (that is, the area subject to the project's influence); forecasting potential growth in population and employment, based on two alternatives (No-Build and Build); interpreting how this growth will translate into potential future land use; and lastly, predicting how the potential future land use may affect natural resources. Due to the overall uncertainties (largely because of the complexities involved, but also in part because of the lack of good historical data), the results of the study of secondary impacts are more informational than something for which specific areas or resources can be designated as requiring mitigation.

Development issues have traditionally been addressed by the municipalities through the administration of land use regulations (zoning, site plan, and subdivision regulations) usually based on local master plans. In recognition of this, an initiative is proposed as part of this project, which supplements the local approach by making available technical assistance relative to land use. The technical assistance includes updating master plans; reviewing and researching site plan, subdivision, and zoning ordinances; developing build out analyses; providing mapping to locate important resources; and in general, providing tools, expertise and recommendations to assist communities dealing with growth issues.

Under the overall coordination of the Office of State Planning (OSP), a steering committee comprised of representatives of State, federal, and regional agencies would direct the work of a dedicated planning group, overseeing a consultant team and design professionals to assist the communities within the greater I-93 study area.

This assistance is complementary with two other ongoing initiatives: the Governor's Initiative on Sprawl and the Grow Smart New Hampshire effort. The Governor's Initiative was administered by the OSP and has involved a wide range of federal, State and regional agencies as well as business interests and advocacy groups. The initial work included a report on sprawl in New Hampshire – a general historical perspective as well as a detailed look at three areas of the State. The report included general goals and objectives for growth as well as recommendations for programs and legislation to assist communities to better assimilate future growth and development. The Grow Smart New Hampshire program is an offshoot of the Governor's Initiative on Sprawl and is in recognition of the widening of I-93 and its potential to spur growth. The OSP, NHDES and NHDOT, in conjunction with the U.S. EPA, have coordinated resources and funded the program. The program selected three communities within the area influenced by the widening of I-93, and proposes to identify steps each might take to handle future growth effectively. In addition, a Grow Smart tool kit, training, as well as informational materials will be developed for use by all communities. To a degree, this program serves as a precursor to this technical assistance program proposed in response to the findings of the I-93 secondary impacts study.

### 4.12.10 Conclusions

Given the complexities of land use, transportation, economics and environmental regulation, it is not possible to attribute and predict with certainty the secondary land use impacts associated with improvements to an existing transportation infrastructure. Improvements to existing infrastructure do to some degree enhance the economic climate for subsequent development, but whether over time the secondary growth would have occurred regardless of the infrastructure improvements is not known. Beyond this basic question of whether secondary impacts will occur, the questions of degree and location are equally difficult to answer.

This analysis attempts to provide some insight as to what the future might hold. In doing so, it attempts to provide local officials, planners, and public citizens an estimate of the existing situation and the possible future situation relative to potential development activity that might be fostered by the widening of I-93 from Salem to Manchester. Using the Expert Panel and a variation of the Delphi process, it appears that widening I-93 would induce some additional growth beyond what might be expected by 2020 if the highway were not widened. Using the Panel's blended average allocations for this Study Area, the additional growth in total may be in the range of 5%. Within New Hampshire, the Study Area communities may experience an additional growth in population of over 35,000 people and in employment of nearly 16,000 jobs by 2020 because of the widening of I-93. Through the use of this information, stakeholders can be better informed as to the magnitude of growth and how to adapt their local ordinances and zoning codes to accommodate future growth. The GrowSmart New Hampshire initiative is being carried forward to develop information to assist communities on how they might manage growth. In addition, Statewide GIS mapping projects such as the aforementioned Co-occurrence study, provide information relative to areas within communities that need to be protected given their high degree of natural resource value. Additional assistance in the form of a land use technical assistance program would expand upon these initial efforts to provide ideas and tools so communities might better accommodate and direct growth that is coming regardless of the final composition of I-93.

## 4.13 Hazardous Materials

### 4.13.1 Impact Methodology

An impact related to a petroleum and hazardous material release site or building demolition is determined to exist if a selected alternative has the potential to encounter contamination or building demolition is required. When an impact is identified, specific procedures may be implemented to define the nature and extent of that impact as it relates to the specified alternative. In general, an identified impact for a potential release site or potential building demolition does not necessarily indicate that a certain alternative is less desirable. Contaminated properties or building demolition can usually be managed efficiently and cost effectively during construction.

## 4.13.2 Potential Project Impacts and Mitigation

### 4.13.2.1 Potential Petroleum and Hazardous Material Release Sites

Initial Site Assessment (ISAs) were performed for certain properties that could pose a risk to encountering contamination that may impact a selected alterative. An ISA represents the first step in an iterative process to determine if a property could be contaminated. Typical findings of an ISA identify historic releases that have already been documented and potential sources areas that could contribute to contamination (i.e., underground tanks, floor drains, fill areas). Following completion of the ISA and if determined to be warranted, the next step would be to perform Preliminary Site Assessments (PSAs). PSAs included subsurface investigations to determine the nature and extent of any suspect contamination. Subsurface investigation typically included the excavation of test pits, drilling of soil borings, and the installation of groundwater monitoring wells. Soil and groundwater samples collected during the PSA are analyzed by a laboratory to determine if contaminant levels require remediation in accordance with DES regulations.

The following Table 4.13-1 summarizes the 14 properties that could impact an alternative related to petroleum or hazardous material releases. The properties were selected based on the findings of the ISA's, supplemental field reconnaissance, and current property usage.

**Table 4.13-1**
**Summary of Potential Petroleum and Hazardous Material Sites that may Impact an Alternative**

| NHDOT Parcel ID | City | Street | Former/Existing Use | Proposed Impact | Alternatives Impacted | Figure 3.12-1 Map ID |
|---|---|---|---|---|---|---|
| S226 | Salem | Cross Street | Town Maintenance Facility | Limited land tanking along north and westerly property boundaries. | All | 4 |
| S74 | Salem | Keewaydin Drive | Former Manufacturing | Partial land taking for proposed detention basin. | All | 14 |

## Table 4.13-1 (continued)

| NHDOT Parcel ID | City | Street | Former/Existing Use | Proposed Impact | Alternatives Impacted | Figure 3.12-1 Map ID |
|---|---|---|---|---|---|---|
| S173 | Salem | Raymond Avenue | Existing automotive maintenance | Full land taking for proposed park and ride. | All | 81 |
| W104 | Windham | Range Road | Former/existing maintenance garages | Full land taking. | Options 7, 8, 9 | 77 |
| W106 | Windham | Range Road | Existing automotive repair, resale, misc. debris | Full land taking. | Options 7, 8, 9 | 78 |
| W99 | Windham | Route 111 | Existing gasoline station | Full land taking. | All | 29 |
| W44 | Windham | Route 111 | Existing gasoline station | Full land taking. | Options 3, 4, 5, 6, 8, and 9 | 31 |
| W35 | Windham | Route 111 | Existing automotive activities | Full land taking. | Options 3 to 6, 8, and 9 | 82 |
| D25 | Derry | Kendall Pond Road | Maintenance facility | Partial land taking along northeastern property boundary for proposed detention basin. | All | 80 |
| L174 | Londonderry | Londonderry Road | Automotive maintenance and transmission repair | Full land taking. | All | 76 |
| L130 | Londonderry | Route 28 | Existing gasoline station | Full land taking. | Relocated NB ramps and Relocate NH 28 | 66 |
| | | | | Partial land taking. | All | |
| L79 | Londonderry | Rockingham Road | Motorcycle sales and repair | Full land taking | Park and ride option. | 68 |
| | | | | Limited frontage land taking. | All | |

**Table 4.13-1 (continued)**

| NHDOT Parcel ID | City | Street | Former/Existing Use | Proposed Impact | Alternatives Impacted | Figure 3.12-1 Map ID |
|---|---|---|---|---|---|---|
| L81 | Londonderry | Rockingham Road | Existing gasoline station | Full land taking | Park and ride option | 67 |
| | | | | Limited frontage land taking | All | |
| L82 | Londonderry | Rockingham Road | Solid waste transfer station | Full land taking. | Park and ride option. | 52 |

The above list of properties represent the properties that have a probability of encountering contamination that may affect an alternative. ISAs have been completed for several of the above properties (see Table 13.12-2). The steps that will likely occur to further evaluate the above properties includes the following:

- Perform ISAs for the remaining properties that are included within a preferred alternative.
- Based on the ISA results, perform PSAs. The properties that are currently being monitored for contamination (Groundwater Management Permits or GMPs) may require further sampling and analysis but will likely not likely require a full PSA.

Based on the results of the PSAs, contamination may be identified. In the event contamination is identified, the following scenarios are likely:

- Contamination is limited to groundwater that does not warrant remediation and the groundwater will not be encountered during construction.
- Contamination is limited to soil that does not warrant remediation and the contaminated soil will not be encountered during construction.
- The contaminated soil or groundwater identified requires remediation by NHDOT following property acquisition.
- The contaminated groundwater encountered will not be encountered during construction and assessment/remediation is ongoing by the existing property owner as part of an existing GMP.
- If contaminated materials are expected to be encountered during construction, appropriate worker health and safety provisions and waste management

provisions will be identified. Provisions may include health and safety plans (HASPs) and soil/groundwater management plans for excavation and on/off-site management of waste materials. All work will be performed in accordance with DES regulations.

#### 4.13.2.2 Building Demolition

Prior to any schedule building demolition, a comprehensive building audit will be performed to identify and quantify all regulated building materials and special wastes. Building that may require demolition are summarized in Table 3.12-3. Materials and wastes that may be inventoried include the following:

- Asbestos
- Lead-based paint
- Polychlorinated biphenyls (PCBs) within fluorescent light ballasts
- Electrical transformers that may contain PCB dielectric oil
- Mercury-containing fluorescent light bulbs
- Mercy thermostats
- Miscellaneous containers of oil or hazardous materials
- Refrigerants (air conditions, refrigerators)
- Hydraulic lifts
- Aboveground storage tanks
- Underground storage tanks

The scope of each audit will vary based on building type, age, and current use. Residential buildings will likely be limited to asbestos and lead paint audits, while commercial buildings will include a more comprehensive audit for other regulated materials. Based on the findings of the building audits, abatement plans will be prepared to address the removal of all regulated building materials, including asbestos and lead paint.

Other miscellaneous containers of oil and hazardous materials will also be removed prior to demolition. These materials can not be commingled with the general building demolition waste stream. Tank closure assessments will be performed following the removal of every underground storage tank. The assessments will determine if contamination is present and whether remediation is required.

## 4.14 Energy Impacts

Energy to perform construction, in the form of diesel and gasoline fuels, will be required with the Build Alternatives, which involve extensive cuts and fills, including bridges, on new location. The No-Build Alternative would not involve the use of such energy per se, although the condition of the existing infrastructure is poor, and continued maintenance will require more intensive energy dependent work efforts over time.

Since the project will improve the flow of traffic through the corridor, future vehicular energy requirements will be less due to more efficient traffic flow along the highway. Conversely, energy requirements will be higher with the No-Build Alternative because of less efficient traffic flow.

The project with the addition of extra lanes will require additional expenditures of energy as compared to today for maintenance activities. These activities include plowing, sanding, mowing, bridge and drainage system maintenance, and roadway surface repairs. However, because the new roadway surface will be built to improved standards, which incorporate the latest technology and materials, the facility will require less maintenance in the future.

## 4.15. Construction Impacts

### 4.15.1 Effects

Impacts caused by construction activities will occur with any of the alternatives except No-Build. Construction impacts will be short-term, however, and would vary little among the Build Alternatives. Construction activities may result in temporary adverse impacts, with the two primary pollutant sources during construction being construction equipment and exposed soils in unvegetated areas.

Air pollutants emitted from diesel and gasoline powered construction equipment will include oxides of nitrogen, carbon monoxide, hydrocarbons, and particulate matter. Emissions from construction equipment may result in elevated ambient concentrations within the immediate vicinity of construction operations for short periods of time, but are not expected to have a substantial impact.

Particulate matter (dust) will be emitted as a result of grubbing, grading, excavating, hauling, and blasting operations. Dust emitted during most construction activities will be controlled by wetting unpaved areas in the construction zone, covering loads on all open trucks, and seeding all unvegetated areas as soon as practicable. These methods will be employed during construction of any of the alternatives.

Activities associated with construction will likely require blasting of bedrock material in some areas and extensive grading. The grading will include the stripping of existing vegetation, followed by major excavation and filling. This construction will result in nearly complete reworking and/or removal of surficial and subsoils along the sides of highway. Exposure of previously vegetated soils could lead to erosion if not properly controlled.

### 4.15.2 Mitigation

To mitigate potential sedimentation impacts by construction, a well-defined drainage and erosion control program will be implemented. Construction schedules will require that areas stripped of vegetation be limited in size and either surfaced or vegetated as quickly as possible after initial exposure. Temporary erosion checks during the construction period will be installed in appropriate locations. With proper diversions of flow, installation of silt retention basins, and construction carefully scheduled to limit soil exposure, erosion during construction should be minimized. Additional details can be found in *NHDOT's Standard Specifications for Road and Bridge Construction, Section 699, Temporary Project Water Pollution Control (Soil Erosion)*.

Removal of streambank vegetation during construction can impact stream ecosystems. Overhanging vegetation provides a major food source for benthic communities (Minshall 1967), overhead cover for fish, shade, and a buffer to sedimentation. Removal of riparian vegetation could intensify daily water temperature fluctuations and potentially change the benthic macroinvertebrate community composition from leaf litter consumers to algal consumers. Maintaining a buffer strip of vegetation near streams will avoid these impacts. Streamside areas cleared of vegetation will be revegetated as quickly as possible.

Highway construction will unavoidably destroy habitat important to wildlife and thus may kill some animals and displace others. Some fossorial animals and breeding animals and their young will most likely to be lost during construction. More mobile animals will move to other habitats.

Human presence and associated construction noise at new location areas may repel some species of wildlife from the edge of the right-of-way. Animals tend to habituate to constant noise (Busnel 1978), but loud, sudden sounds will be commonplace during construction. The loud noises associated with construction also could mask territorial vocalizations of bird species near the construction, interfering at least temporarily with breeding. Amphibians, which breed more commonly at dusk or night, are less likely to be indirectly affected by the noise.

Construction activities will result in substantial, but temporary, noise impacts to sensitive receptors at various locations along the project's length. Noise levels in the vicinity of construction activities will vary widely depending on the type and number of pieces of construction equipment active at any one time (Table 4.8-3).

It is expected that noise levels exceeding 67 decibels could occur up to 500 feet away from construction activities. Construction noise will, in some areas, be occurring near residences presently experiencing lower noise levels. In general construction will be accomplished during daylight hours, although night-time construction should be expected given the traffic volumes during daylight hours and the need to maintain traffic at these times.

Construction will create increased truck traffic on secondary roads. Access to I-93 will be maintained although unavoidable delays will occur. Temporary delays will be experienced getting on and off I-93 and along the mainline as bridges are worked on, traffic is shifted temporarily from one side to the other, equipment is moved around, and materials delivered. A strict Traffic Control Plan will be instituted to reduce these types of short-term impacts. The plan will include the requirement to maintain 2-lanes of traffic in both directions along the mainline for normal construction activities, and during high volume traffic periods. Businesses and their customers may experience some inconvenience due primarily to construction activities along their frontage on secondary highways in interchange areas. Construction activities will be coordinated with property owners to assure that reasonable access to properties is maintained. Temporary signing and other issues related to temporary relocation of access points caused by construction activities will be appropriately addressed on an individual basis.

Some short-term visual impacts will also occur during construction as land clearing and earth-moving occurs. Additionally, some views will also be disrupted by the presence of temporary construction or access roads that may be needed.

## 4.16 Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

Current congestion along the I-93 corridor impedes travel through the corridor, both north and south, as well as traffic accessing or traveling through the various interchanges. Transportation improvements, like the proposed one, are based upon a comprehensive planning process by the NHDOT. This planning considers the need for present and future traffic requirements within the context of present and anticipated future land-use development. Local short-term impacts and use of resources by the project are thus determined to be consistent with the maintenance and enhancement of long-term productivity for the State as a whole before a highway project is approved.

The types of impacts for all the Build Alternatives in the project corridor would be similar. Most short-term impacts will be associated with construction: noise, temporary impacts to air quality, disturbance of soils, potential sedimentation (temporarily reducing water quality and affecting aquatic communities), potential traffic delays, and temporary visual impacts. Erosion and sedimentation will be minimized during construction through the use of Best Management Practices (BMPs) to avoid impacts to aquatic communities. Other impacts would cease after construction. In comparison, short-term benefits of construction will include additional employment and an additional source of revenue to the local service industry. Increased local spending during construction would also benefit the economy of the communities in the corridor.

Socio-economic impacts will include some loss of residences, businesses, and agricultural land; possible changes in the value of residences affected by the highway widening and other modifications to the infrastructure; and some loss of tax revenue due to right-of-way (ROW) acquisitions necessary for the widening, the realignment of some cross roads, and for interchange modifications. Some of the necessary ROW acquisition may impact land planned for future development, both residential and commercial. These economic impacts will be compensated for in the long term, however, by improved access within the region. Loss of residences and businesses will impact communities, but the impacts can be absorbed because there are adequate residential and commercial properties for sale or lease in the project corridor to accommodate those displaced. The fiscal impacts to the towns and the economic impacts caused by direct displacements and the loss of property for transportation needs may in the near term be difficult, but over time the redevelopment potential would appear to exceed the immediate losses in terms of value.

With regards to long-term impacts on natural resources, the loss of some forest and natural land will incrementally reduce the rural ambience and appeal of the area. The permanent loss of wildlife habitat will also result in some reduction in the animal populations currently living within the project corridor. However, this latter effect will be offset by the habitats created in the wetland mitigation areas as well as by the permanent protection of habitats in areas purchased for preservation purposes. The potential loss of historic structures is less easily mitigated and typically represents more permanent losses in terms of from the cultural environment.

## 4.17 Irreversible and Irretrievable Resource Commitment

Implementation of the project will involve a commitment of a range of natural, physical, human, and fiscal resources. Land used in the construction of the proposed facility is considered an irreversible commitment during the time period that the land is used for a highway facility. However, if a greater need arises in the future for use of the land or if the highway facility is no longer needed, the land can be converted to another use. At present, there is no reason to believe such a conversion will ever be necessary or desirable.

Considerable amounts of fossil fuels, labor, and highway construction materials such as cement, aggregate, and bituminous material will be expended. Additionally, large amounts of labor and natural resources will be used in the fabrication and preparation of construction materials. These materials are generally not retrievable. However, they are not in short supply and their use will not have an adverse effect upon continued availability of these resources. Any construction will also require a substantial one-time expenditure of both State and Federal funds which are not retrievable.

The commitment of these resources is based on the concept that residents in the immediate area, region, and State will benefit by the improved quality services which are anticipated to outweigh the commitment of these resources.